



# Solar Occultation from Air and Space: SOLVE II Results and Other SOSST Proposed Research

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Ric Kolyer<sup>1</sup>, Jens Redemann<sup>3</sup>, and Stephanie Ramirez<sup>3</sup>

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# Research Tasks in Our SOSST Proposal



- Stratospheric Aerosol Climatology from SAGE II and CLAES
- SAGE III Validation and Related Science:  
SOLVE II Data Analyses
- SAGE III and Related Algorithm Studies using Airborne Sunphotometer Data
- Necessary Updates to the SAGE III ATBD
- Radiative Forcing by SAGE III-Measured Aerosols

# 2 Papers in Press



Bauman, J.J., P.B. Russell, M. A. Geller, and P. Hamill, A  
Stratospheric Aerosol Climatology from SAGE II and  
CLAES Measurements

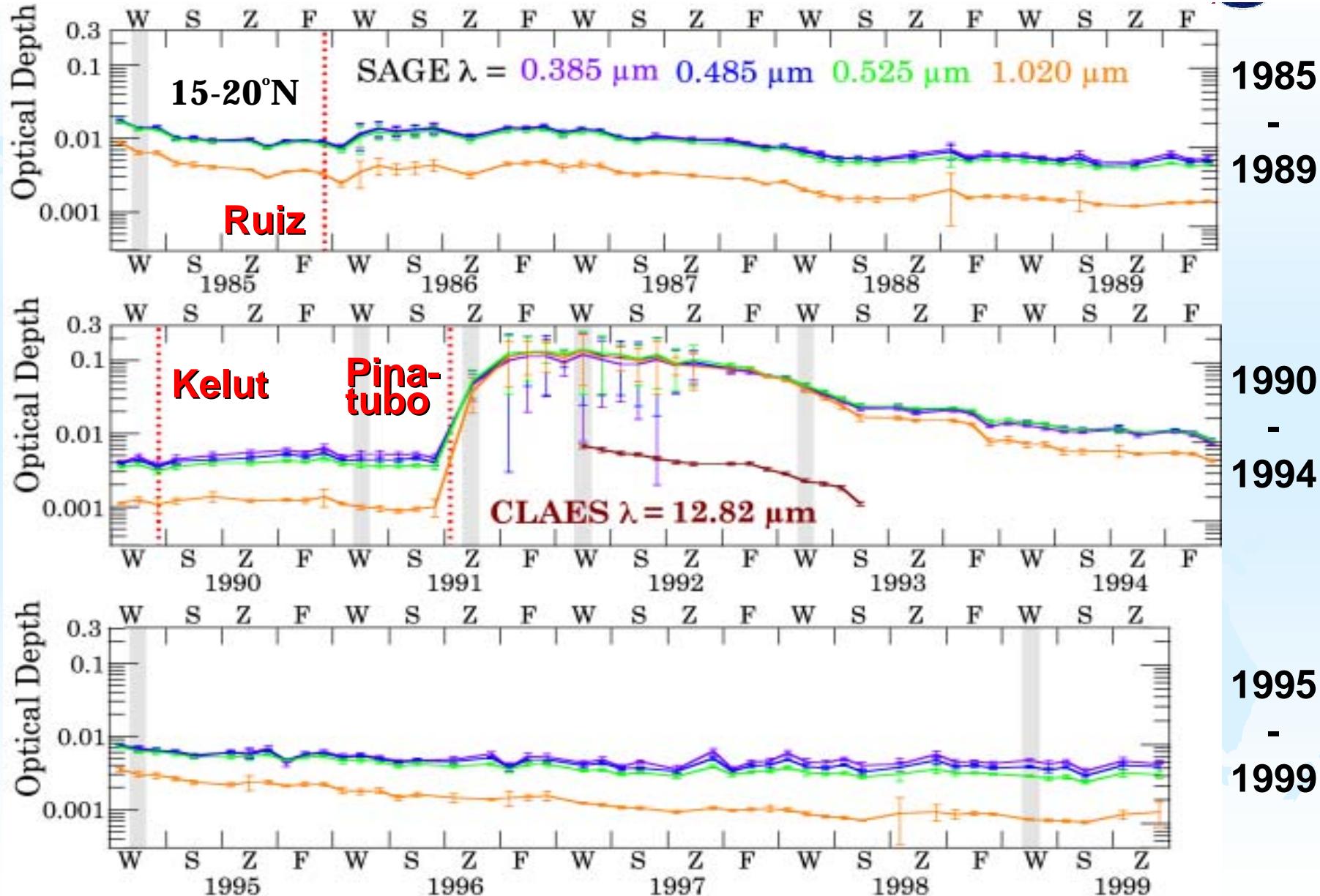
- Part 1: Methodology, *J. Geophys. Res.*, ms# 2002JD002992
- Part II: Results and Comparisons, 1984-1999, *J. Geophys. Res.*, ms# 2002JD002993

## Plans:

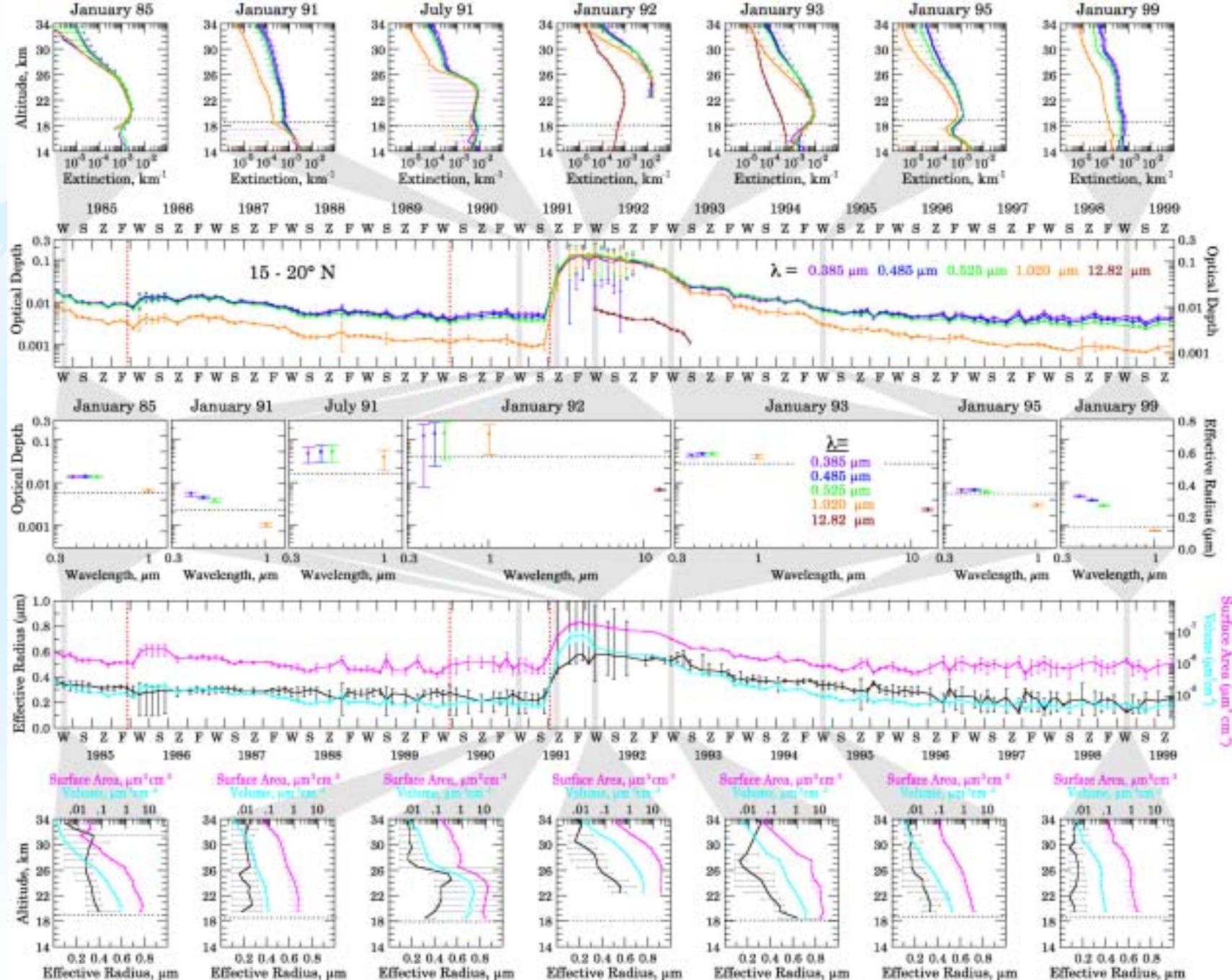
- Complete publication (proofing of AGU figures, etc.). Pay page charges.
- Make data available to community:
  - CD
  - LaRC Atmospheric Science Data Center?

## Example Use: Northrup-Grumman NPP Synthetic Scenes

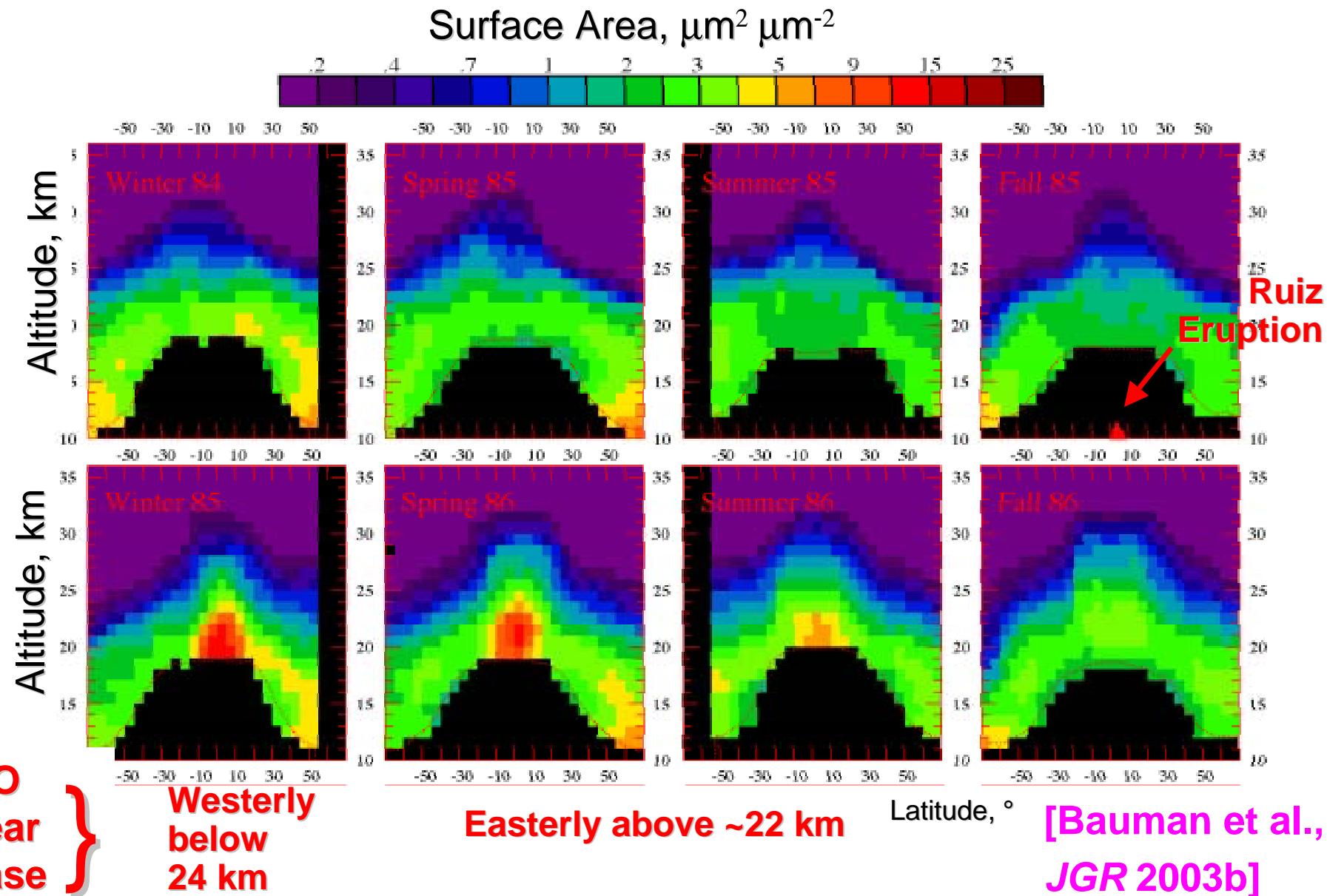
# ~15 Year Climatology of SAGE II & CLAES Extinction



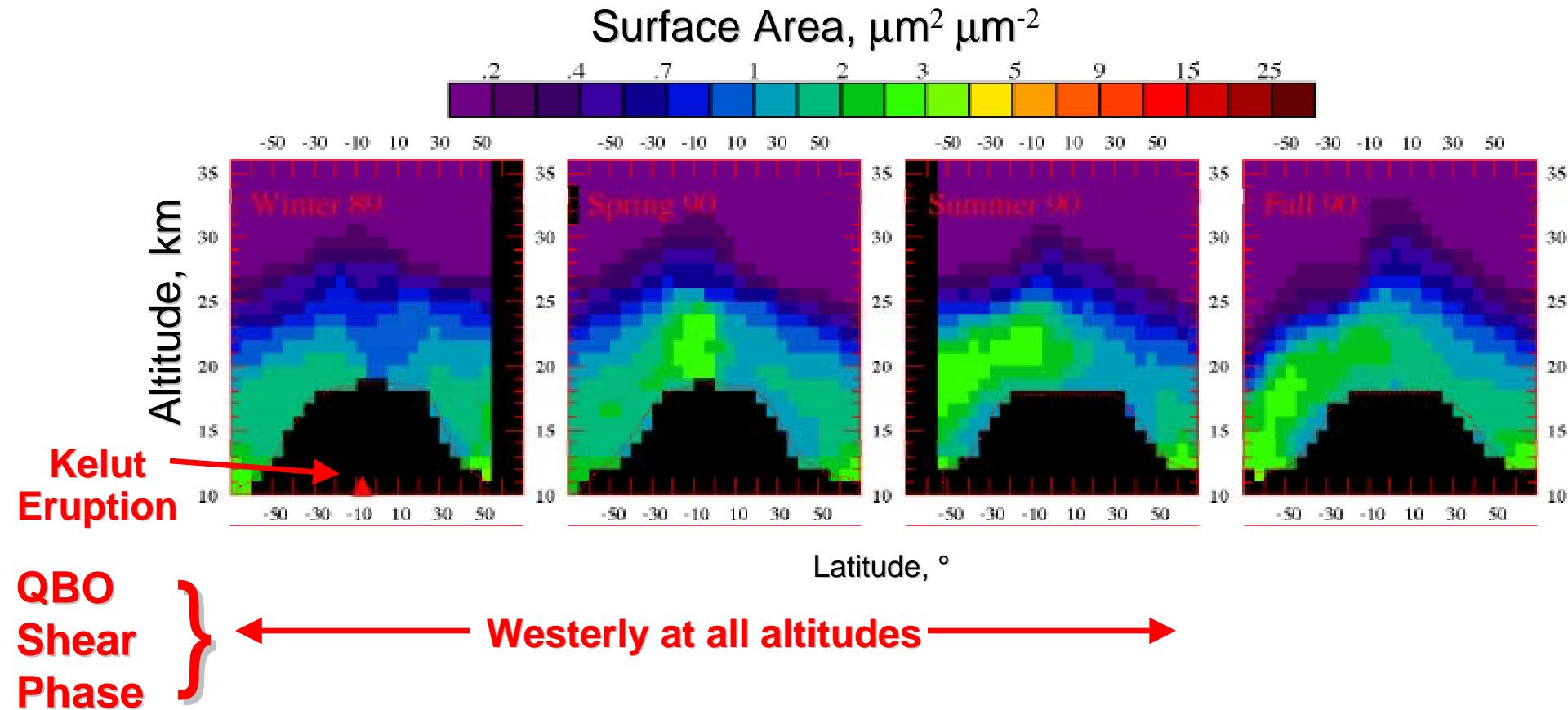
[Bauman et al., JGR 2003b]



# QBO phase predicts spread of tropical volcanic injections: 1. Ruiz

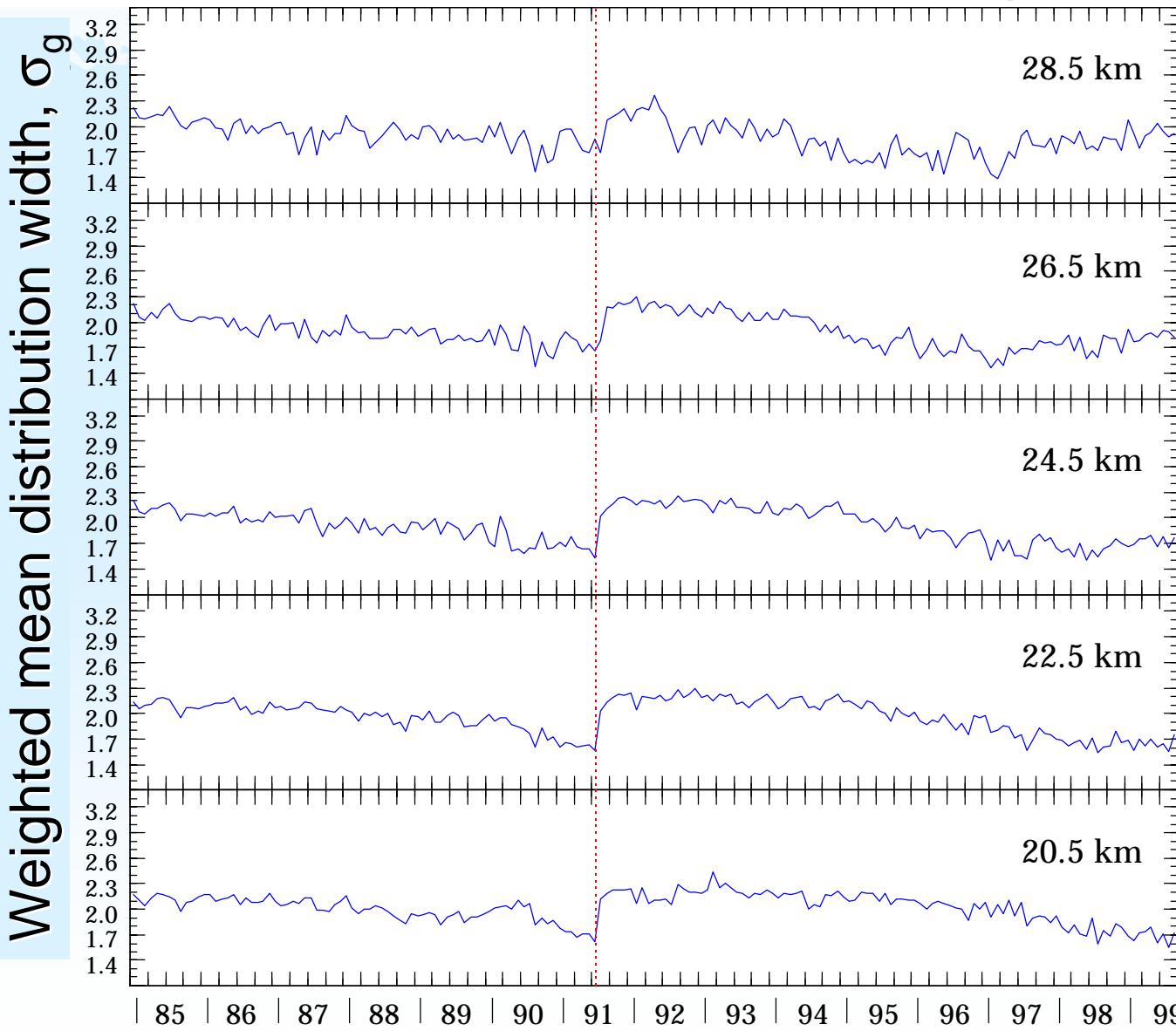


# QBO phase predicts spread of tropical volcanic injections: 2. Kelut



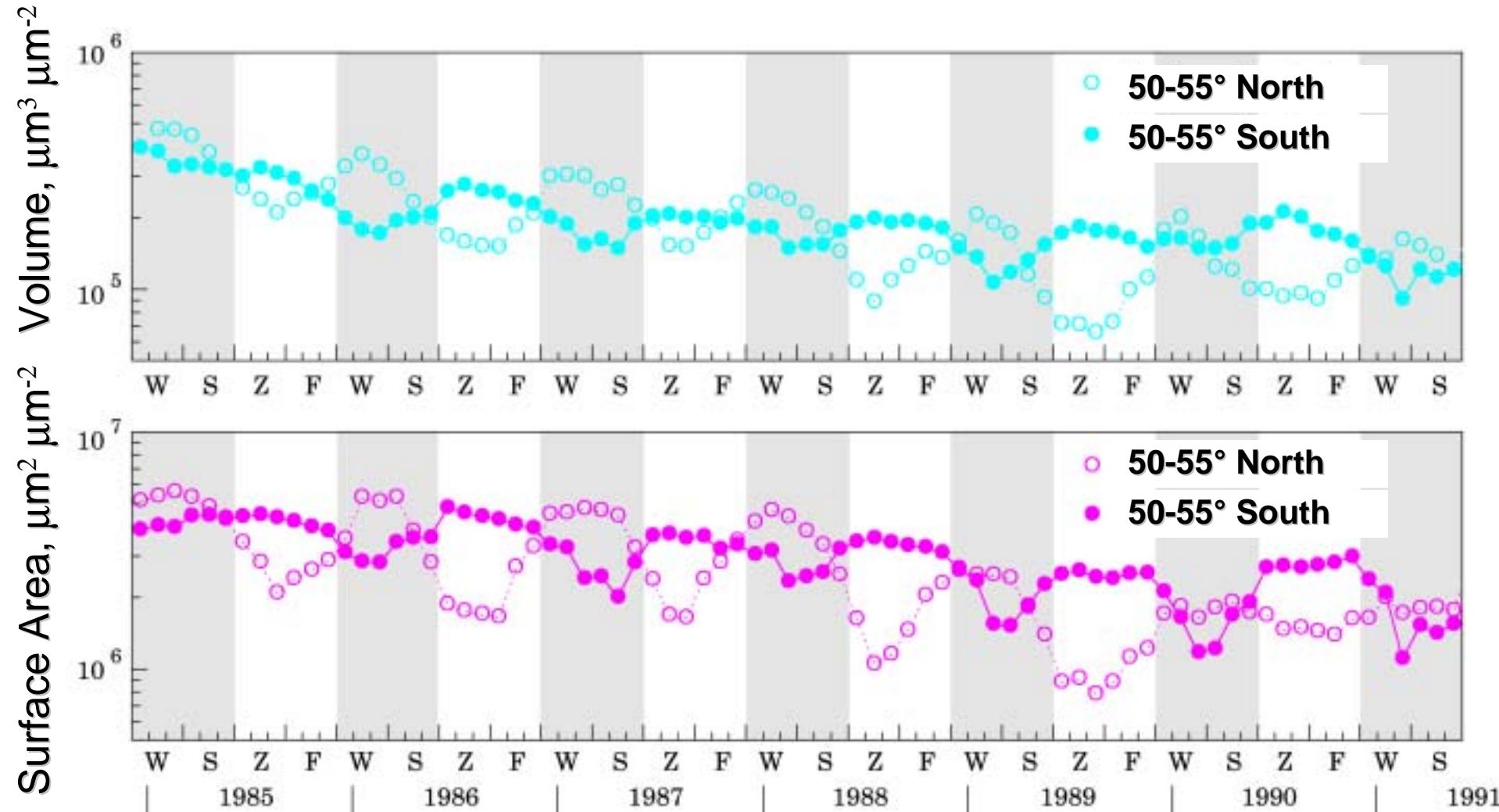
[Bauman et al., *JGR* 2003b]

# Size distribution width varies systematically in response to volcanic injections



[Bauman  
et al., JGR  
2003b]

# Seasonal variations in S and V are most pronounced in the Northern Hemisphere

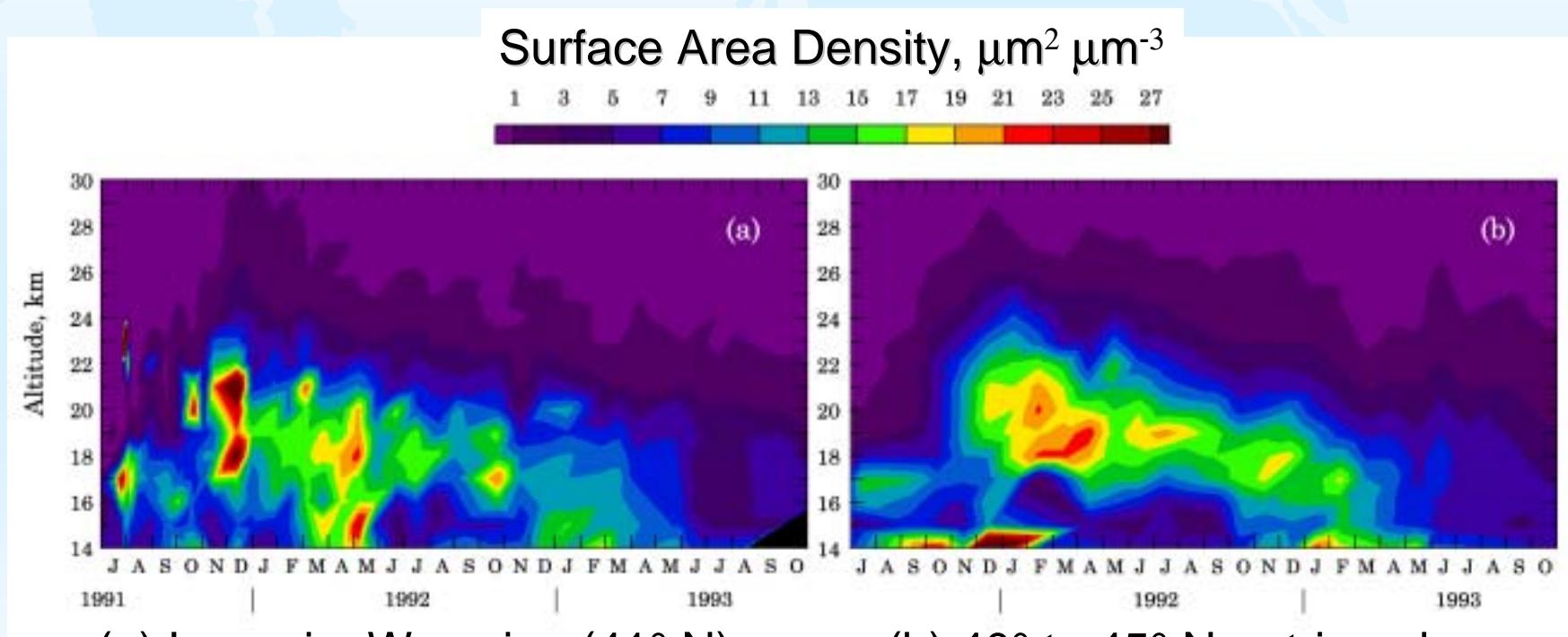


[Bauman et al., JGR 2003b]

# Comparison of Surface Areas

## Derived from Balloonborne Size Distributions

## and SAGE II-CLAES Extinction Spectra



(a) Laramie, Wyoming ( $41^\circ$  N),  
derived by Deshler *et al.* [1993]  
using lognormal fits to *in situ*  
size distributions.

(b)  $40^\circ$  to  $45^\circ$  N, retrieved  
from SAGE II & CLAES  
using LUT

[Bauman *et al.*, *JGR* 2003b]

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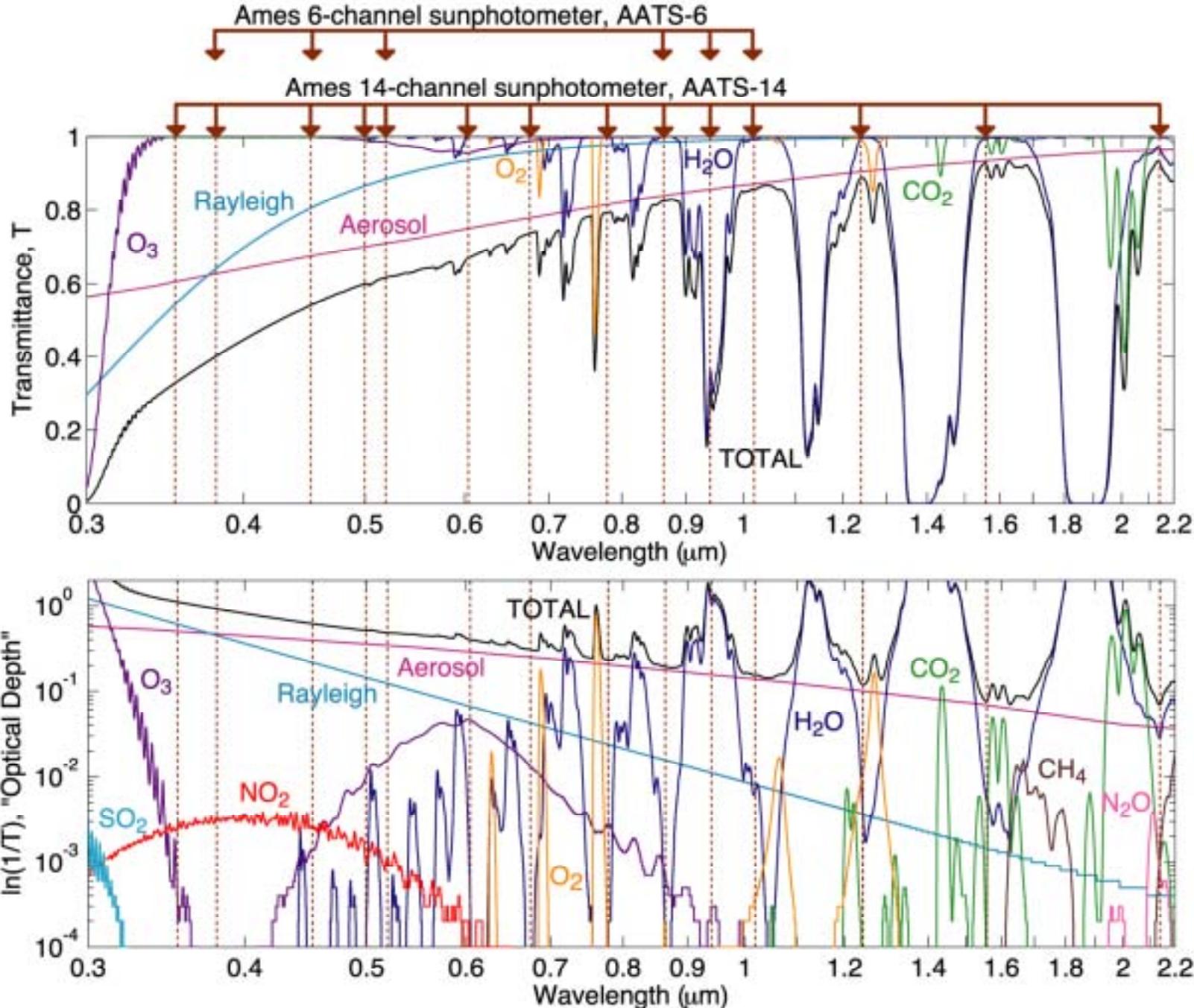
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# AATS-14 on DC-8 in SOLVE II





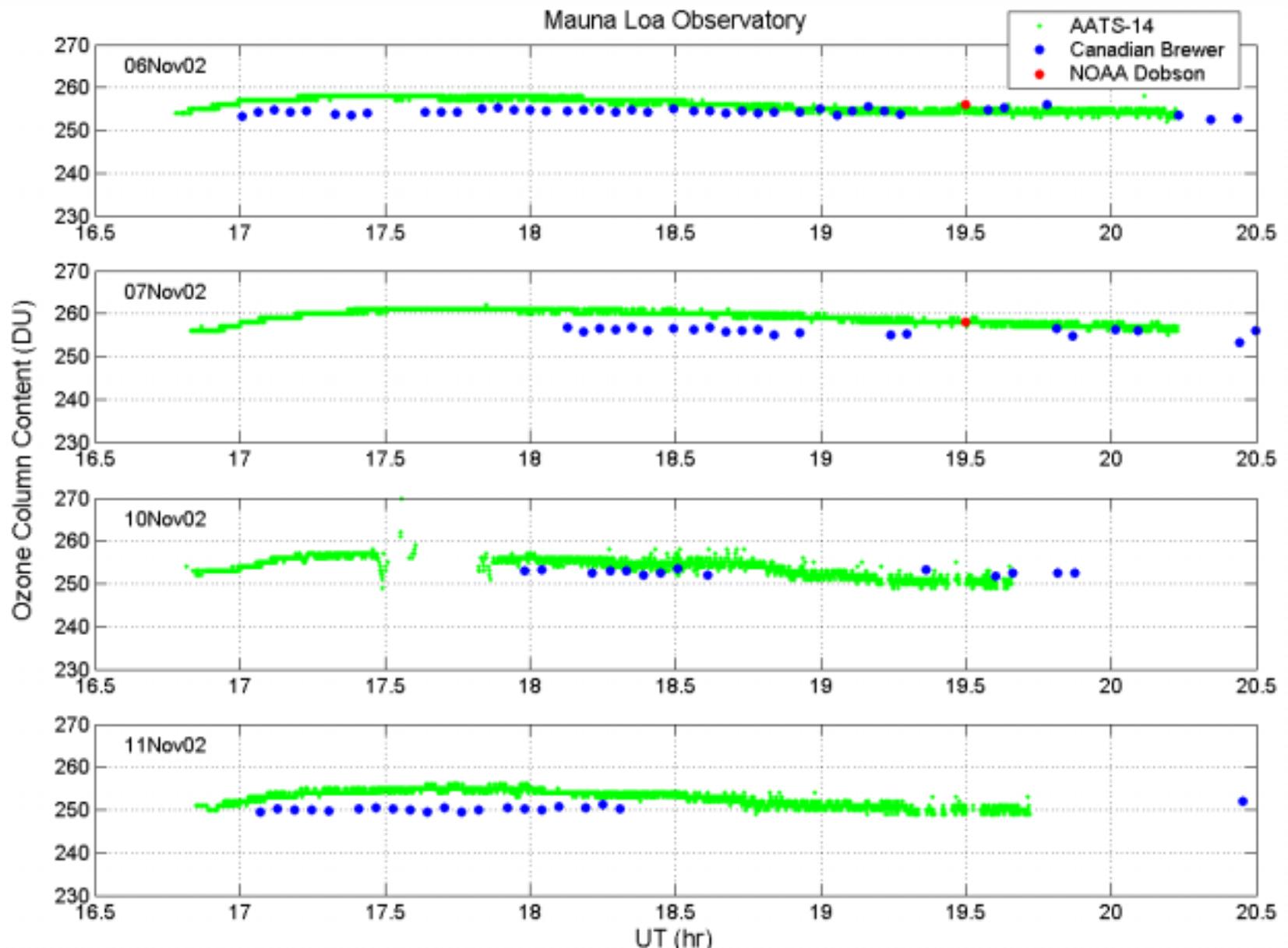


# **Ames Sunphotometer (AATS-14) on DC-8 in SOLVE II**



## **8 Successful Science Flights: Example Results**

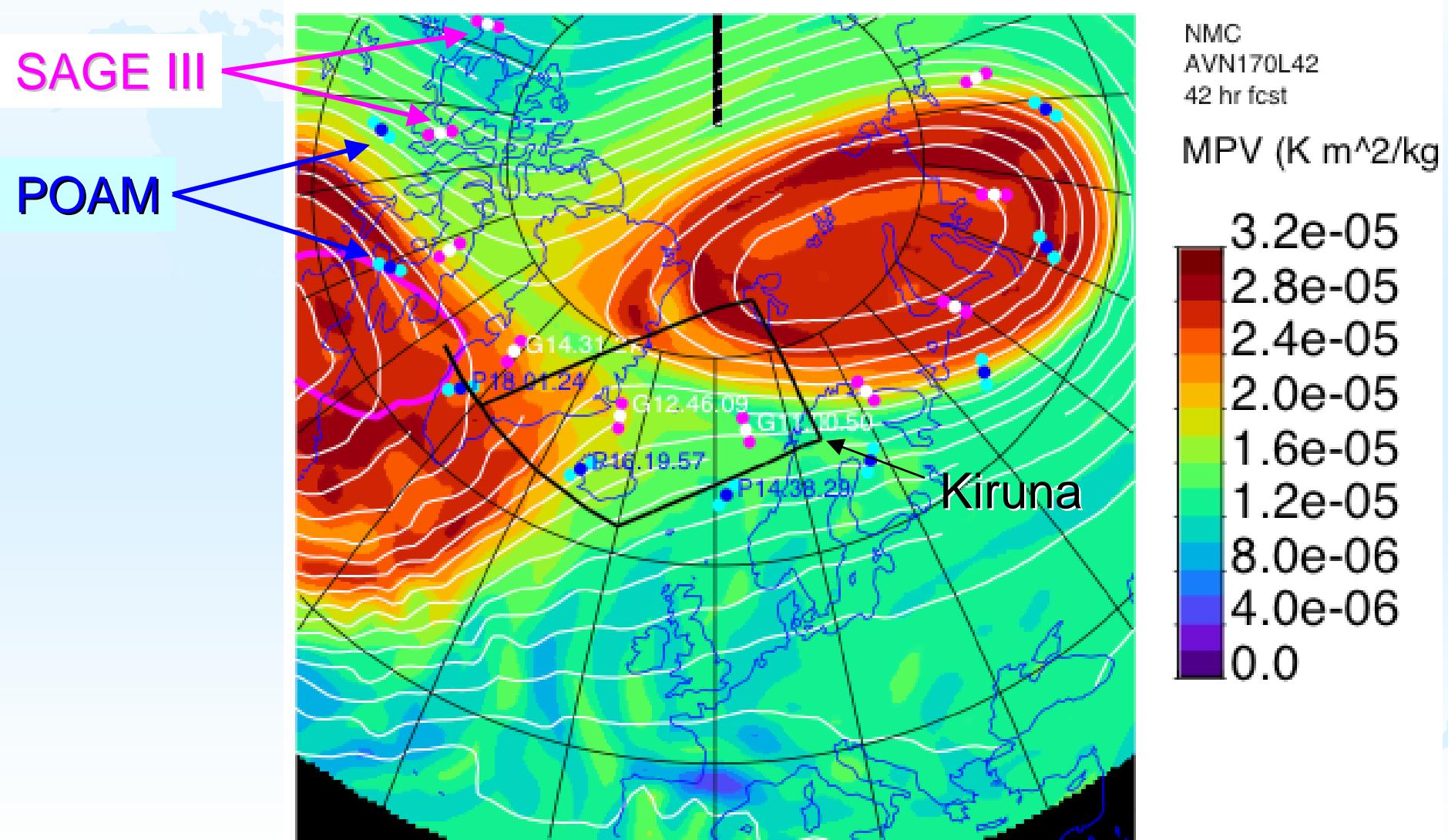
- Ozone
- Aerosol
- Water Vapor
- Spatial Structure
- Spectra vs Wavelength
- Vertical Profiles

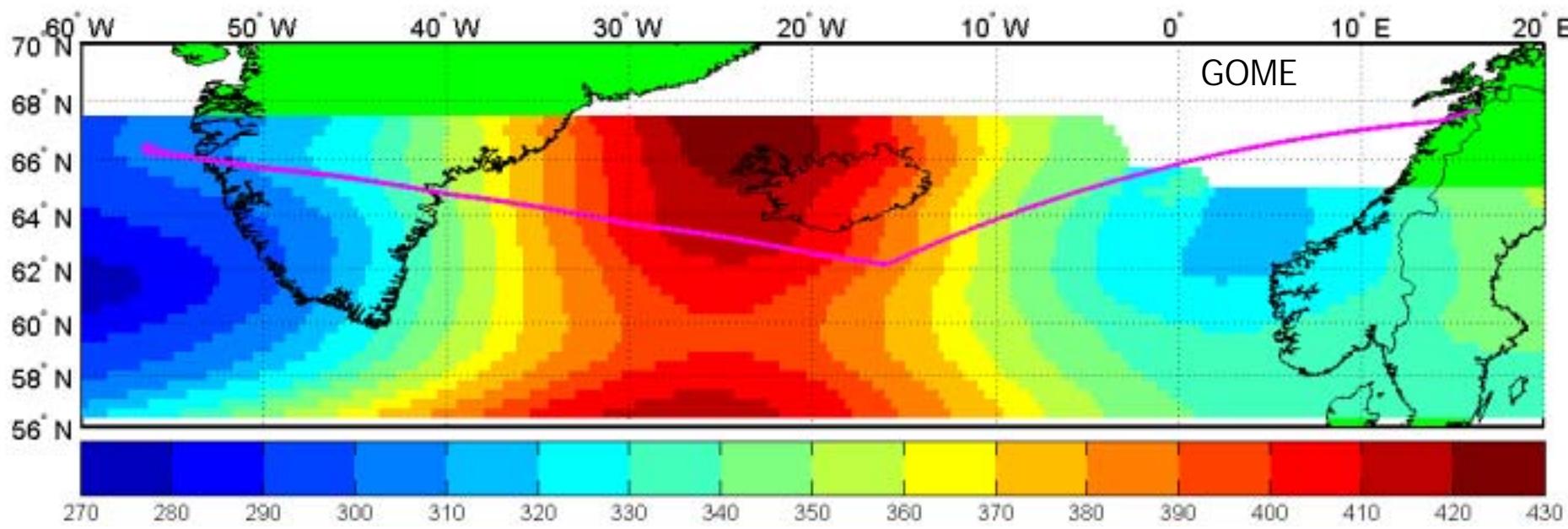


Brewer Data Courtesy of Ken Lamb, International Ozone Services

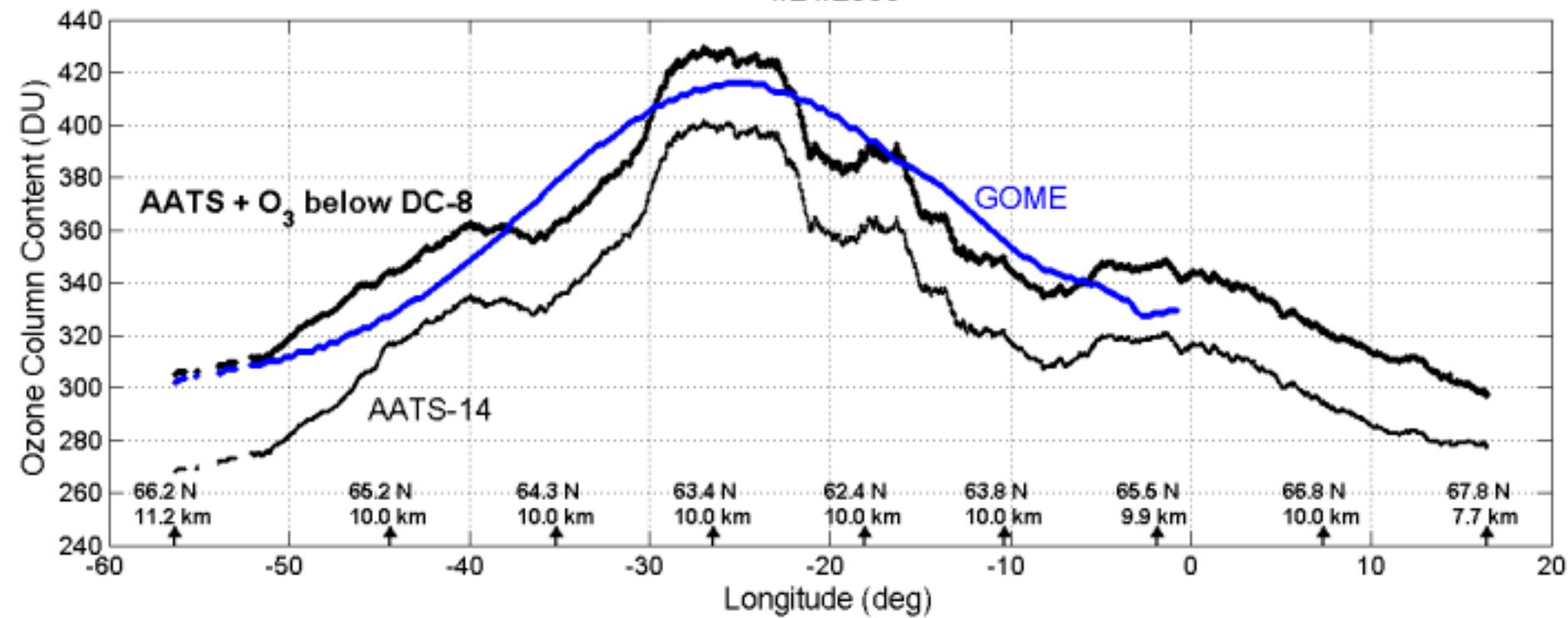
# DC-8 Flight Path, 21 Jan 2003, SOLVE II

18 UTC on 21 January, 2003 - 460K

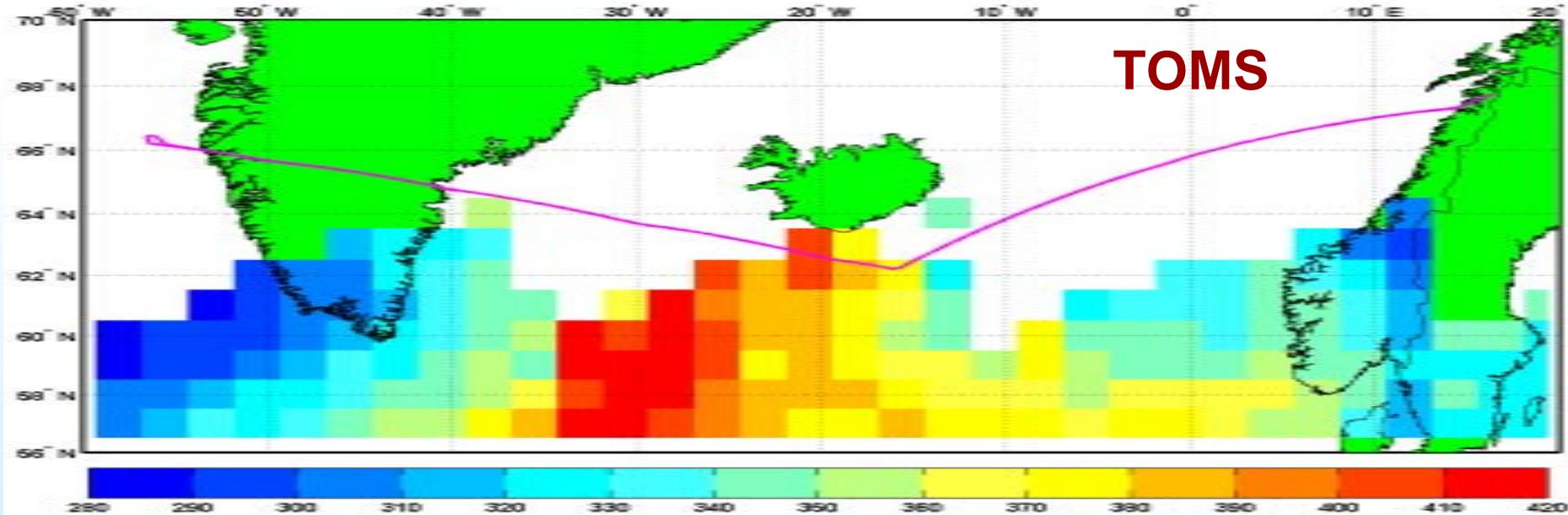




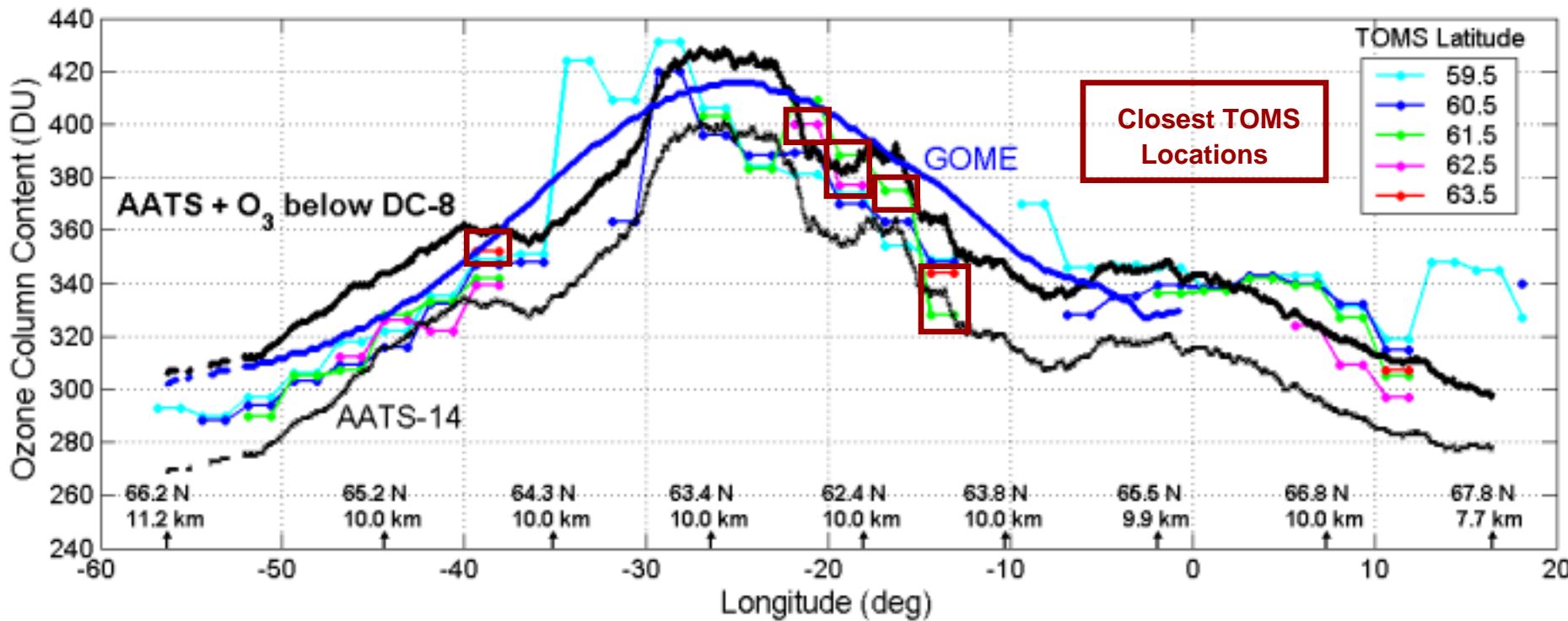
1/21/2003



TOMS

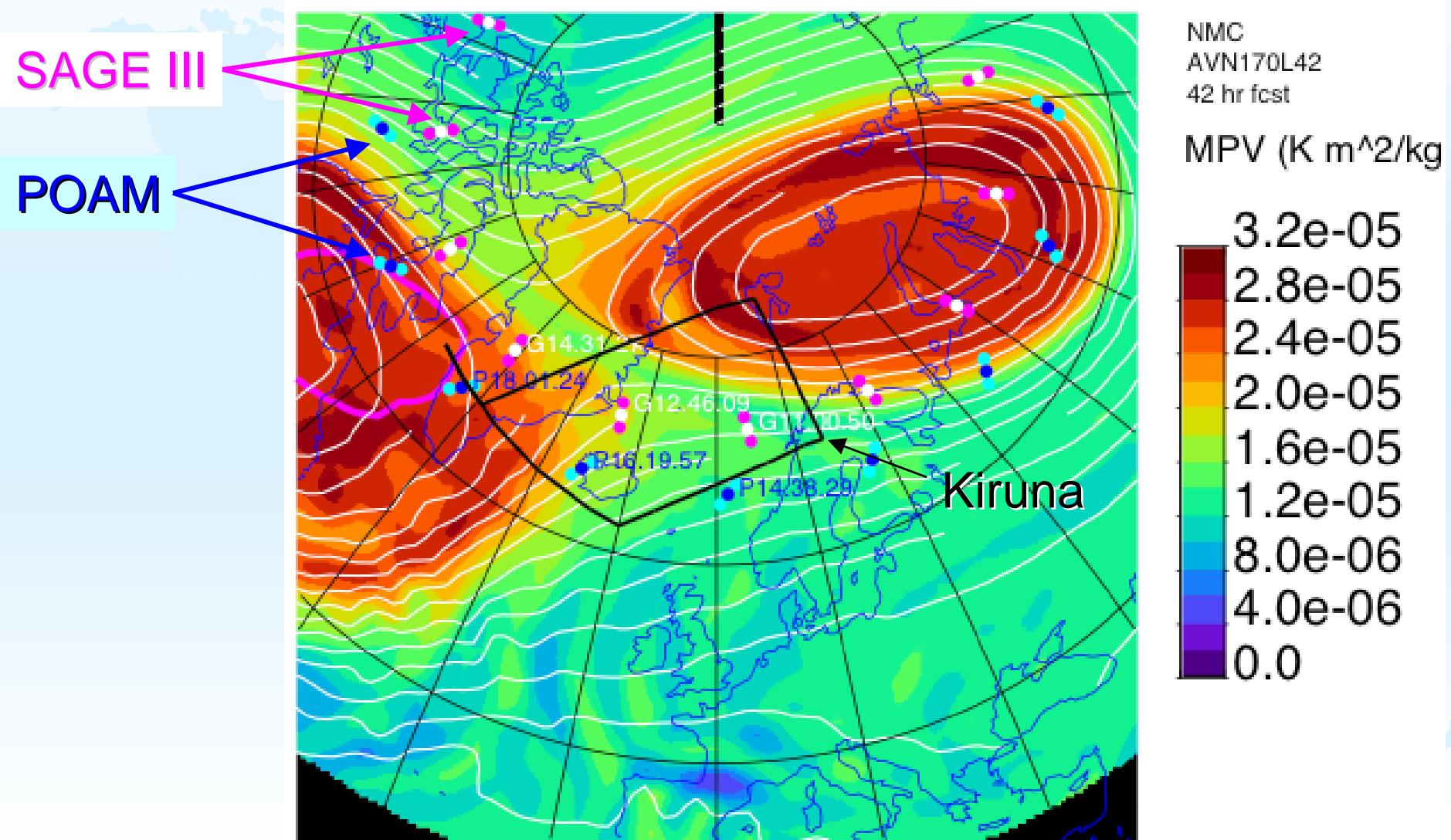


1/21/2003



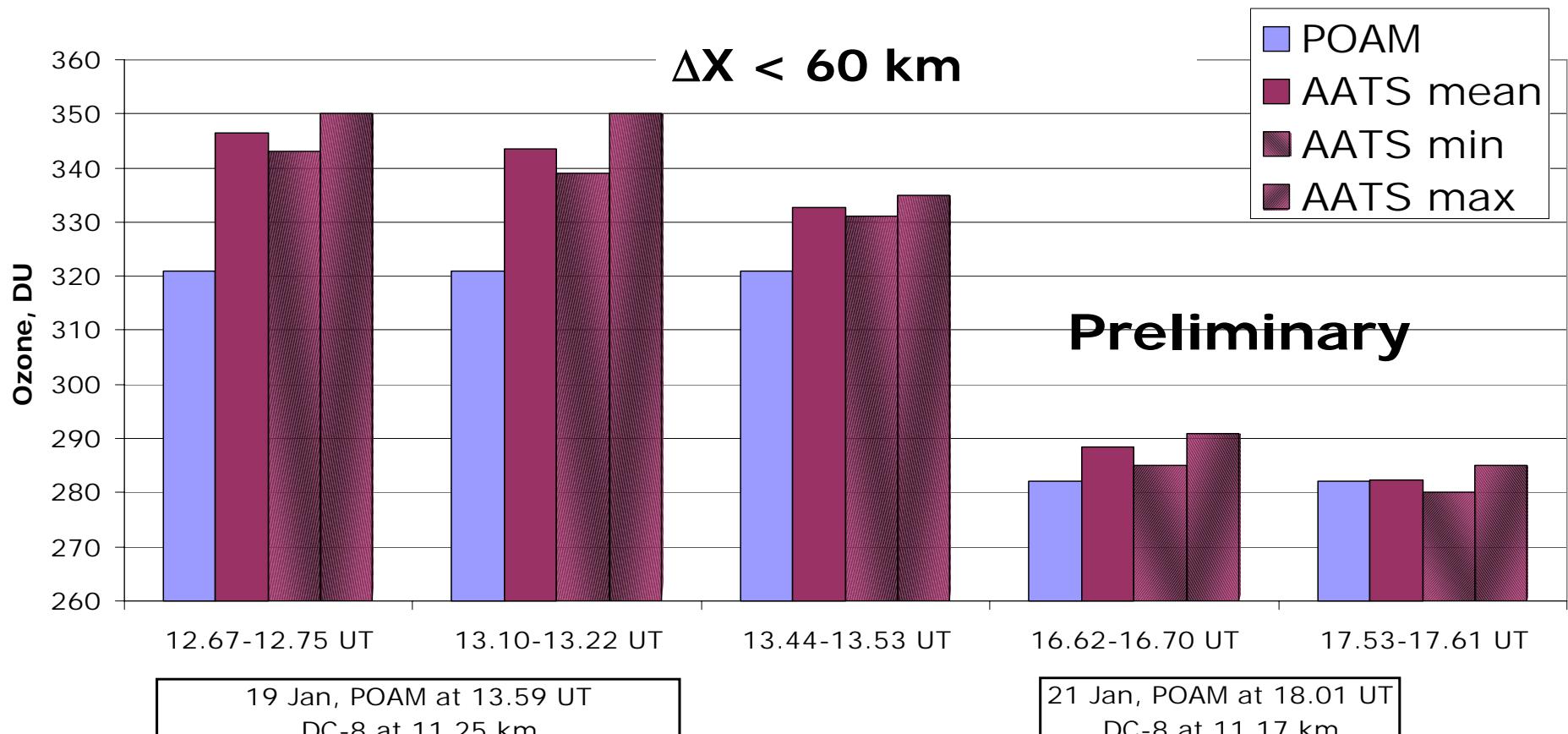
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18 UTC on 21 January, 2003 - 460K





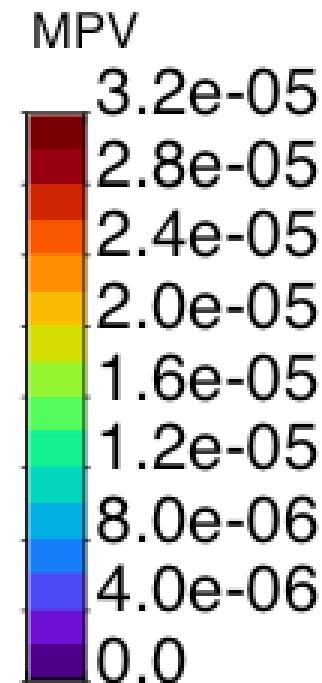
## AATS-14 & POAM Ozone, SOLVE II



# DC-8 Flight Path, 24 Jan 2003, SOLVE II

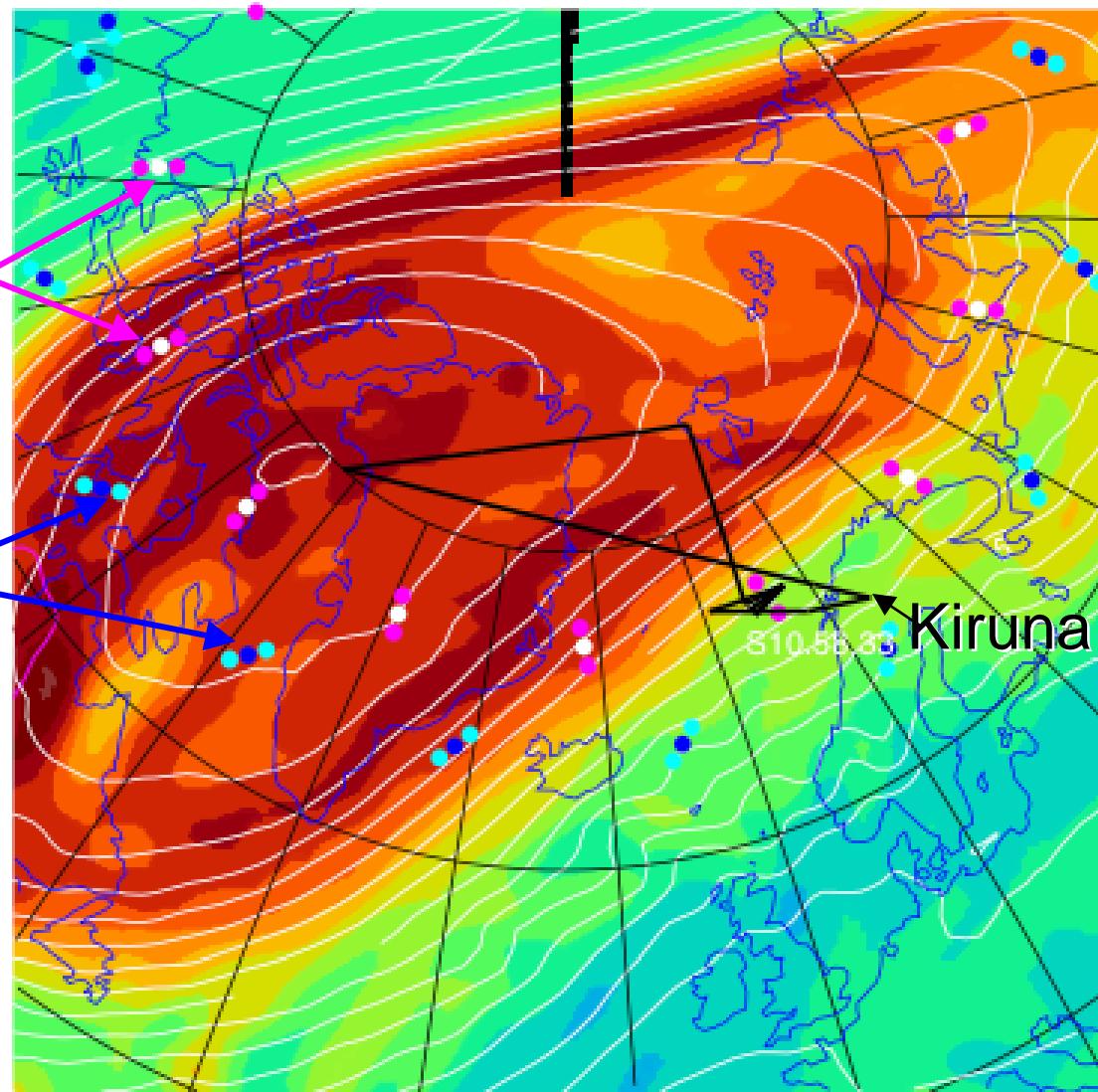
12Z Jan. 24, 2003 - 460 K

NMC  
AVN170L42  
24 hr fcst

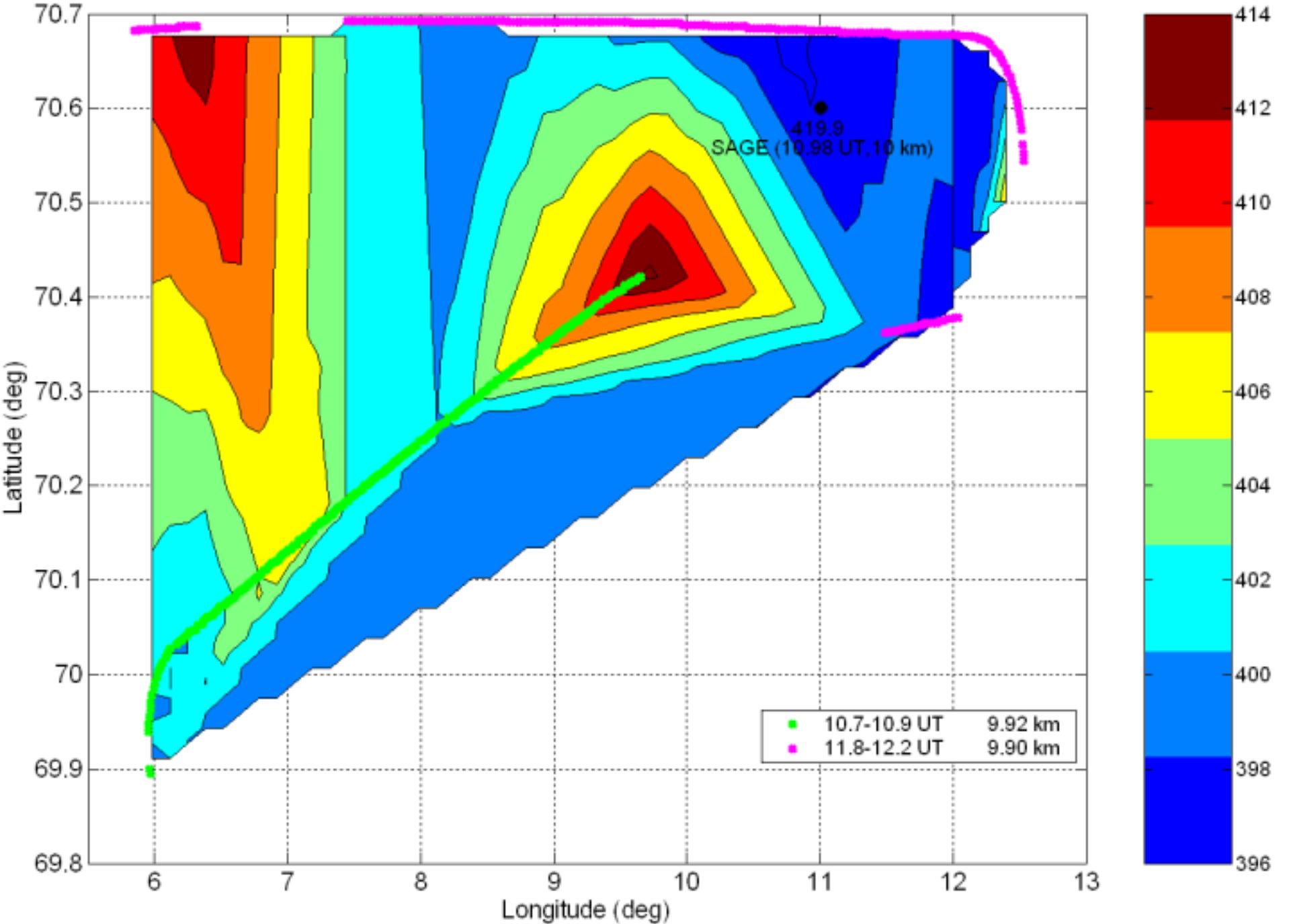


SAGE III

POAM



# AATS-14 Ozone Column Content: 24 Jan 2003

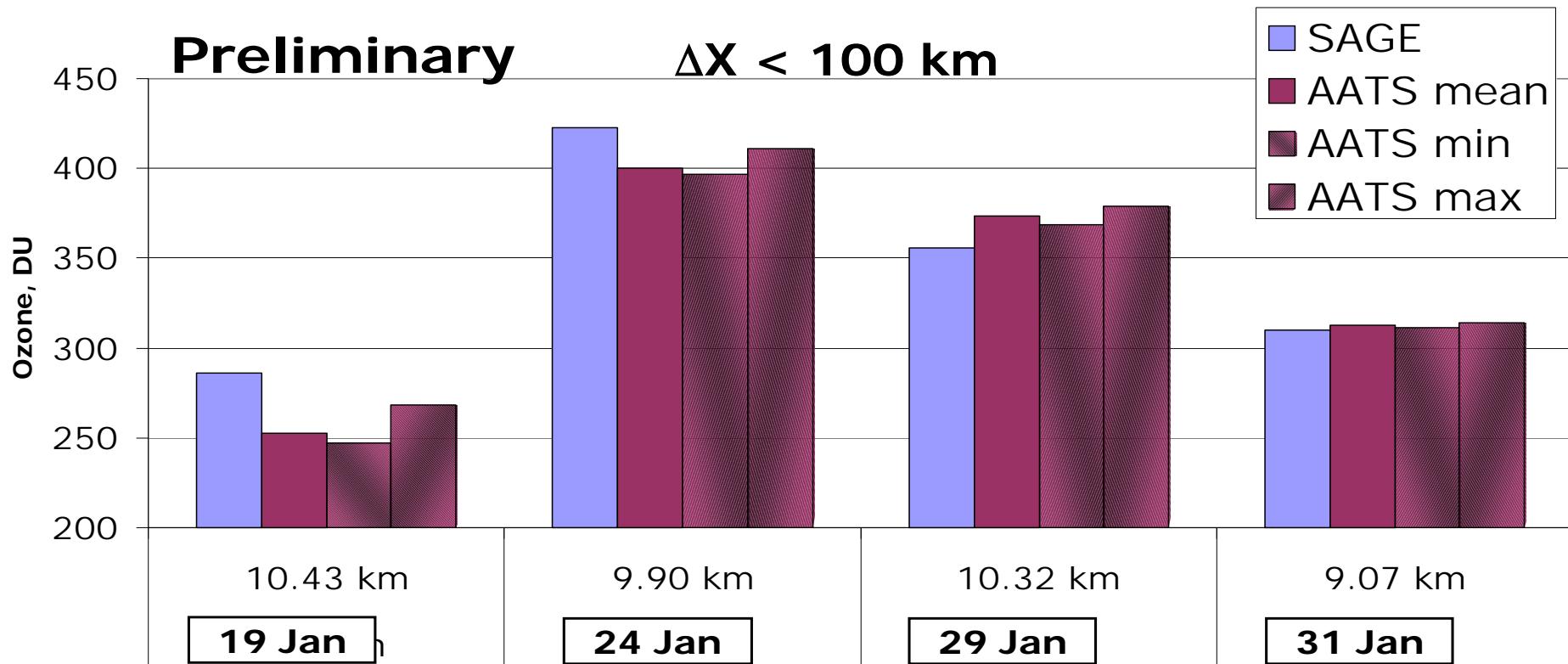




## AATS-14 & SAGE III Ozone, SOLVE II

Preliminary

$\Delta X < 100 \text{ km}$



# Ames Sunphotometer (AATS-14) on DC-8 in SOLVE II

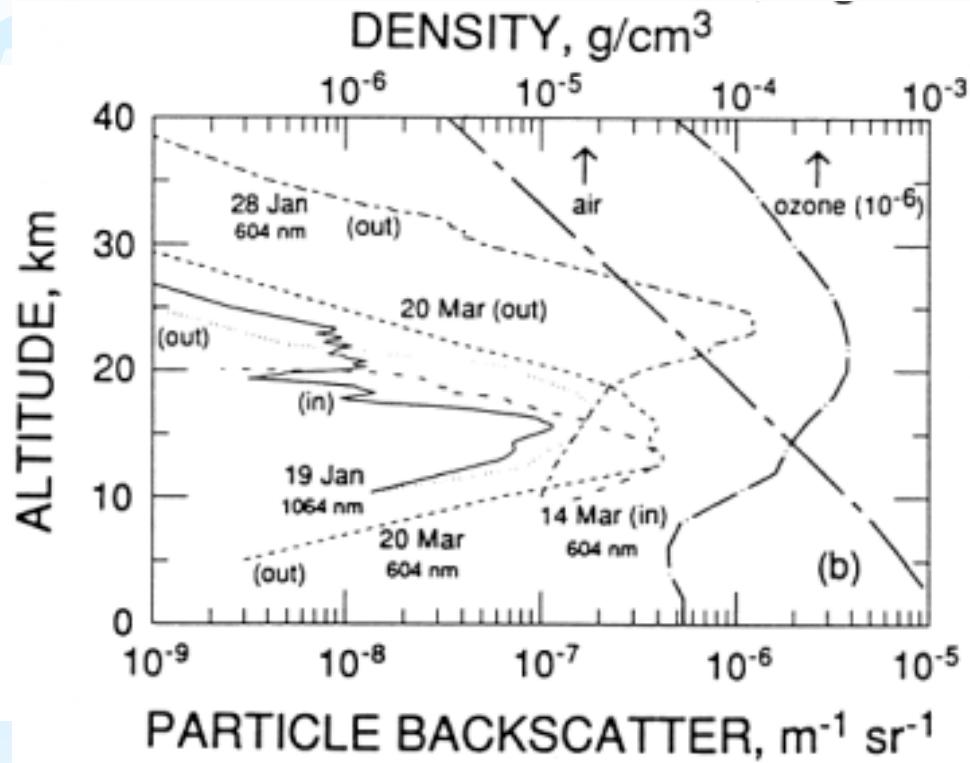
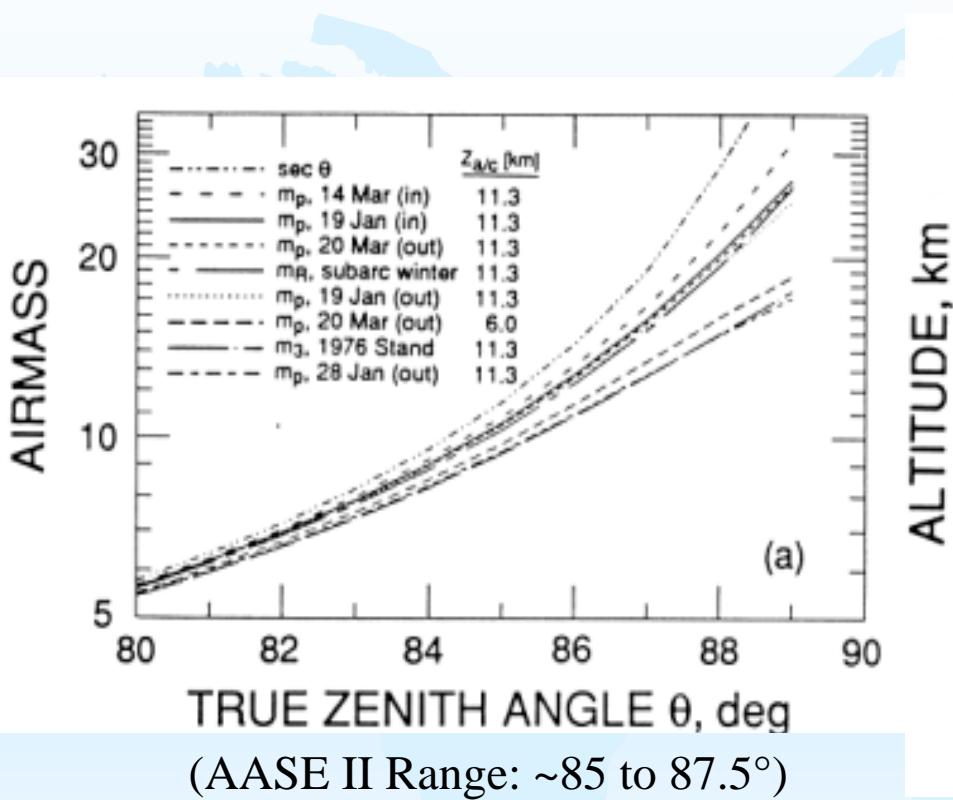


## 8 Successful Science Flights: Example Results

- Ozone
- Aerosol
- Water Vapor
- Spatial Structure
- Spectra vs Wavelength
- Vertical Profiles



# Airmass is very sensitive to vertical distribution When sun is near horizon (SZA > 89°)



[GRL 20, 2571–2574, 1993]

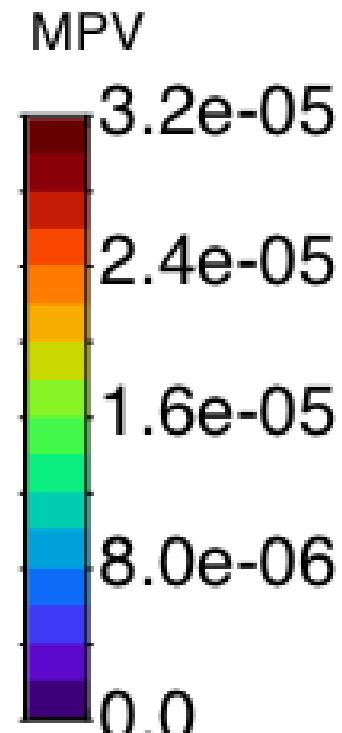
$$\text{Airmass} = \text{OD}_{\text{sun-viewing path}} / \text{OD}_{\text{vertical}}, \\ \text{assuming homogeneity in spherical shells}$$

If AATS optical depth (OD) is too sensitive to airmass, we may do SAGE III validation comparisons in path OD, rather than vertical OD.

# DC-8 Flight Track, 19 Jan 2003

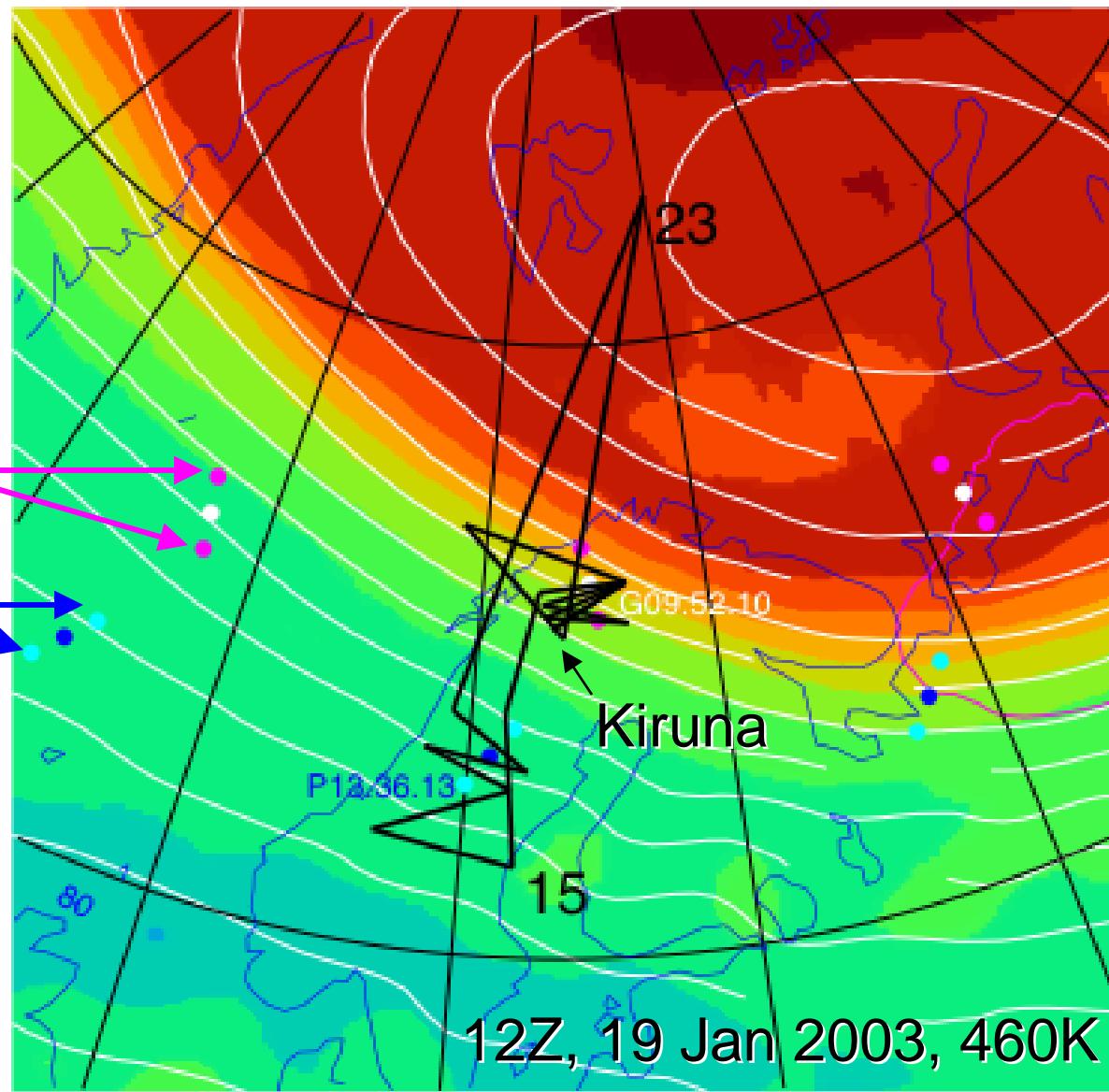


NMC  
AVN170L42  
36 hr fcst

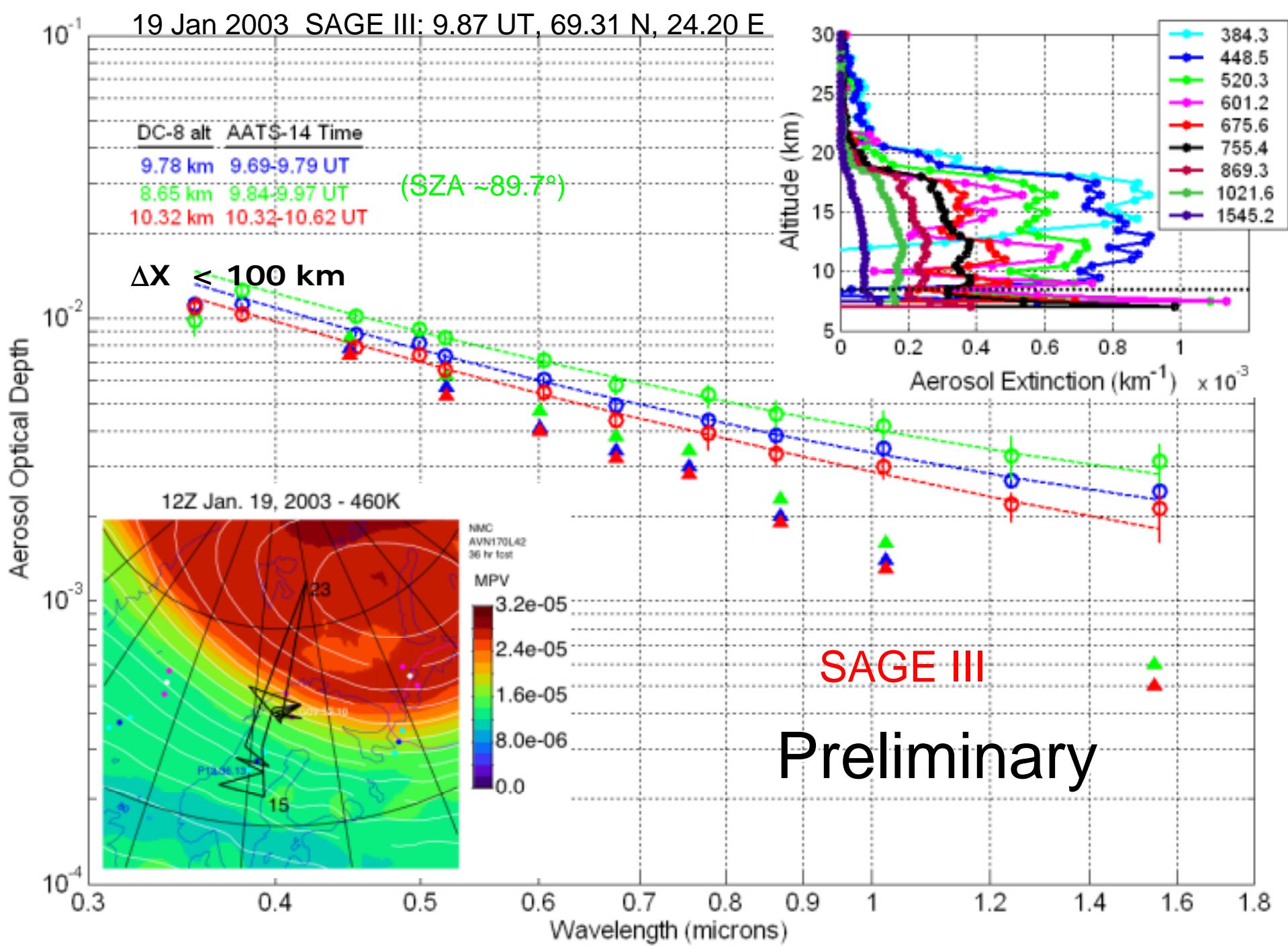


SAGE III

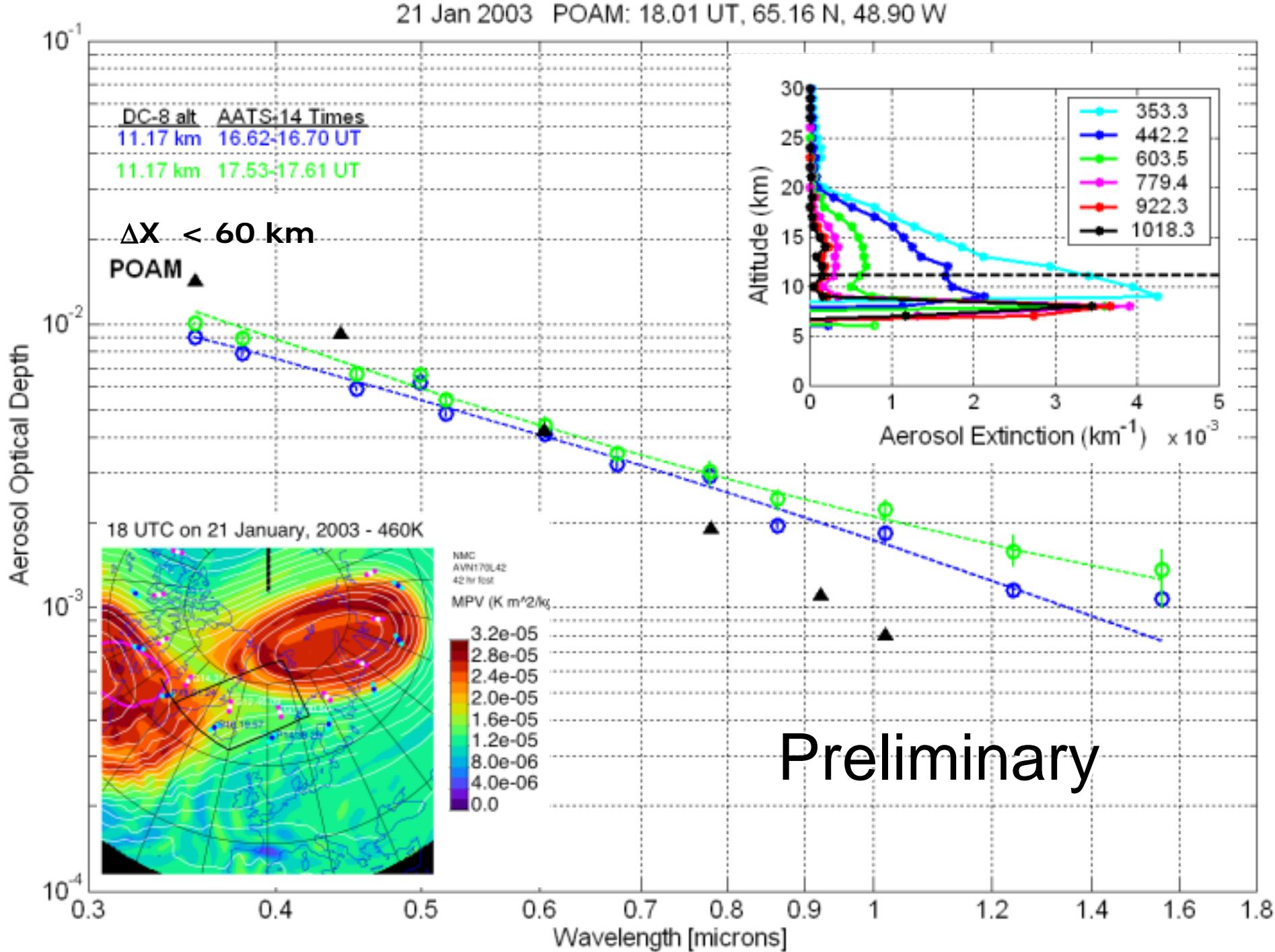
POAM



19 Jan 2003 SAGE III: 9.87 UT, 69.31 N, 24.20 E



21 Jan 2003 POAM: 18.01 UT, 65.16 N, 48.90 W





# AATS-14/SAGE III Coincidences in SOLVE II

DATE	SAGE UT	SAGE Lat	SAGE Lon	AATS UT ( $\Delta X < 100$ km)	Min Separation (km)
19 Jan	9.87	69.31 N	24.20 E	9.84-9.97	14.9
24 Jan	10.98	70.60 N	11.01 E	11.02-11.40	3.1
29 Jan	10.33	72.00 N	25.74 E	10.70-10.98	23.5
31 Jan	9.72	72.55 N	36.90 E	9.45-9.76	24.0

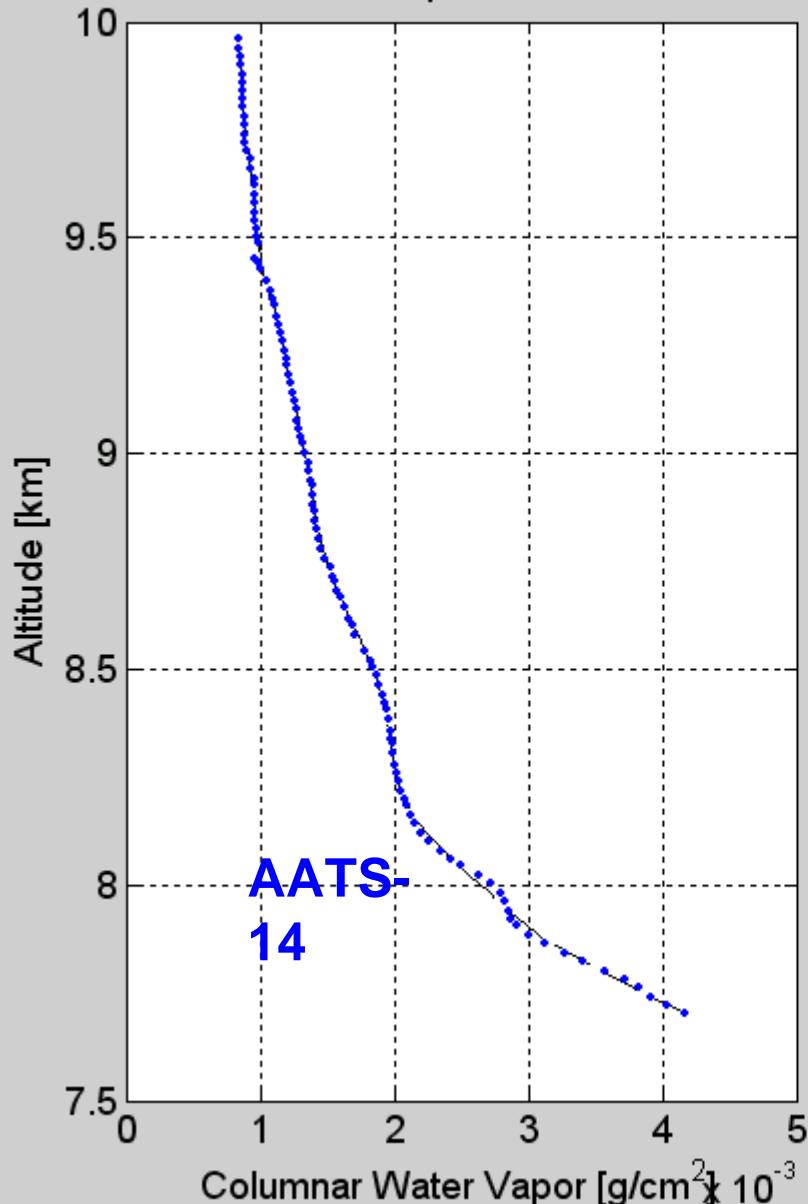
# **Ames Sunphotometer (AATS-14) on DC-8 in SOLVE II**



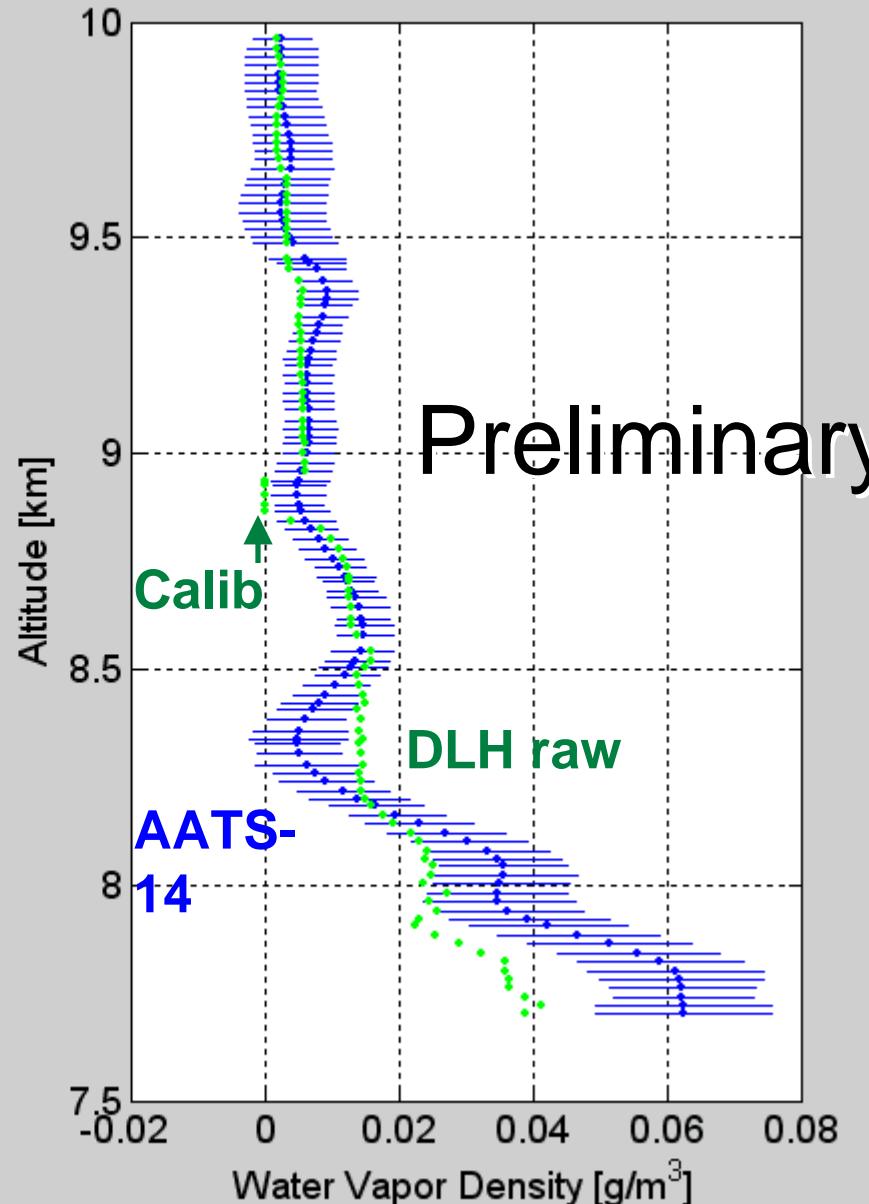
## **8 Successful Science Flights: Example Results**

- Ozone
- Aerosol
- Water Vapor
- Spatial Structure
- Spectra vs Wavelength
- Vertical Profiles

# NASA Ames Sunphotometer SOLVE2



1/21/2003 0-12.74 UT



[DLH Data: G. Diskin, J. Podolske]

P. Russell et al., SO SST Meeting  
Williamsburg, VA, 6-8 May 2003

# In Conclusion



The data set from our 8 successful SOLVE II science flights is extensive and varied:

- Ozone
- Aerosol
- Water Vapor
- Spatial Structure
- Spectra vs Wavelength
- Vertical Profiles

First-Year SOSST Plan: Analyze and publish this data set in collaboration with scientists from

- SAGE III
- POAM
- GOME
- TOMS
- SOLVE II, including the other DC-8 sun viewers:  
GAMS/LAABS & DIAS



# AATS-14 Installation Inside DC-8

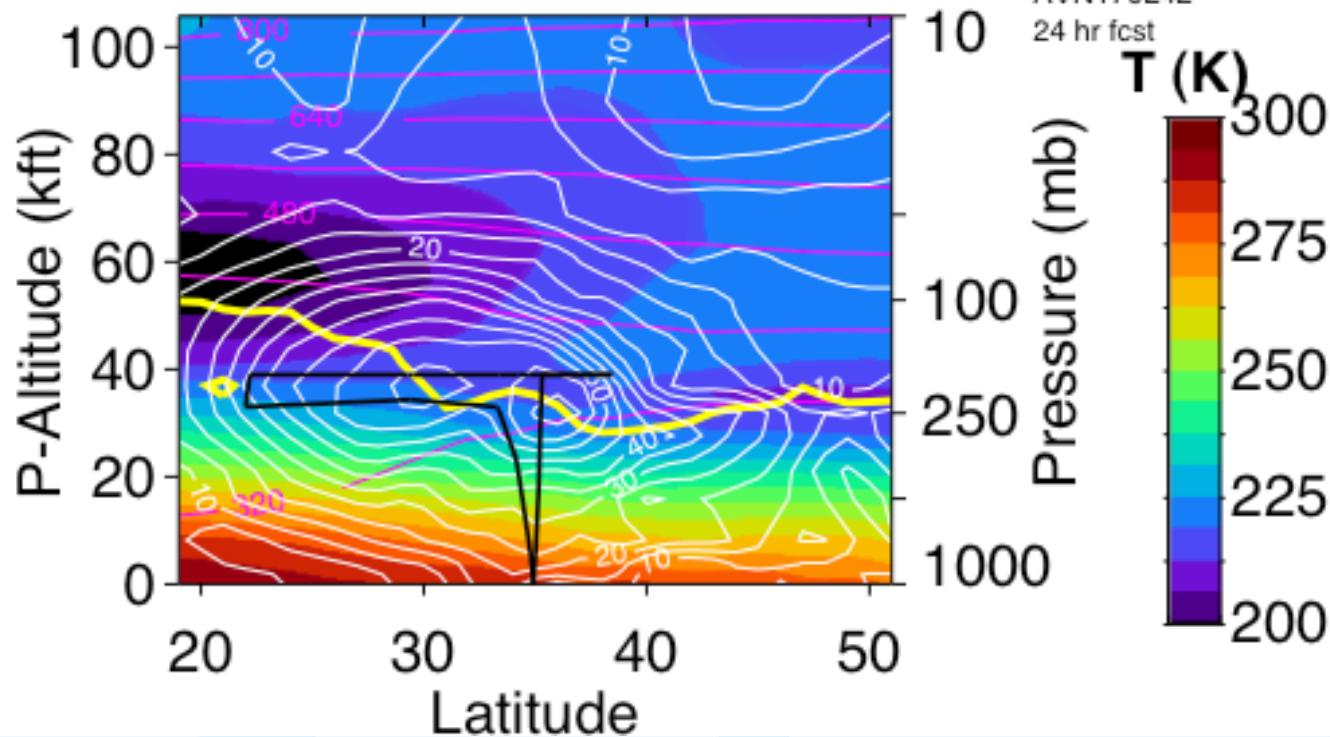


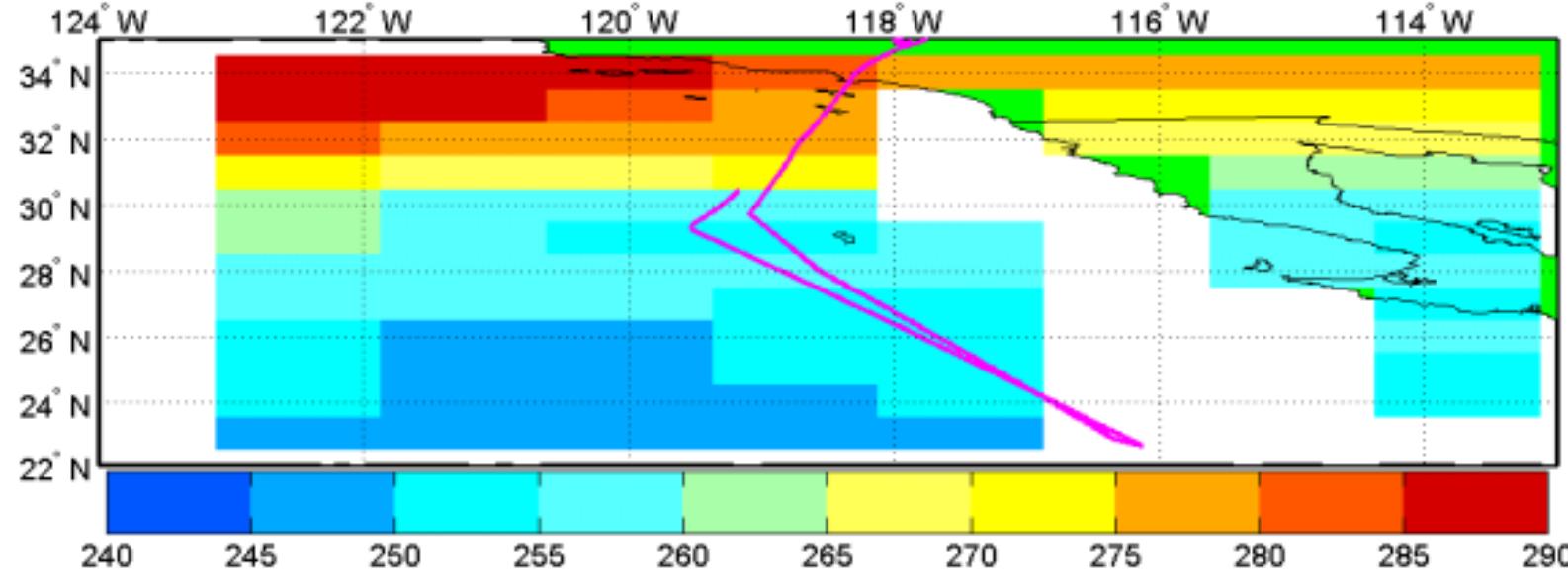
Photo courtesy of Rick Shetter

36

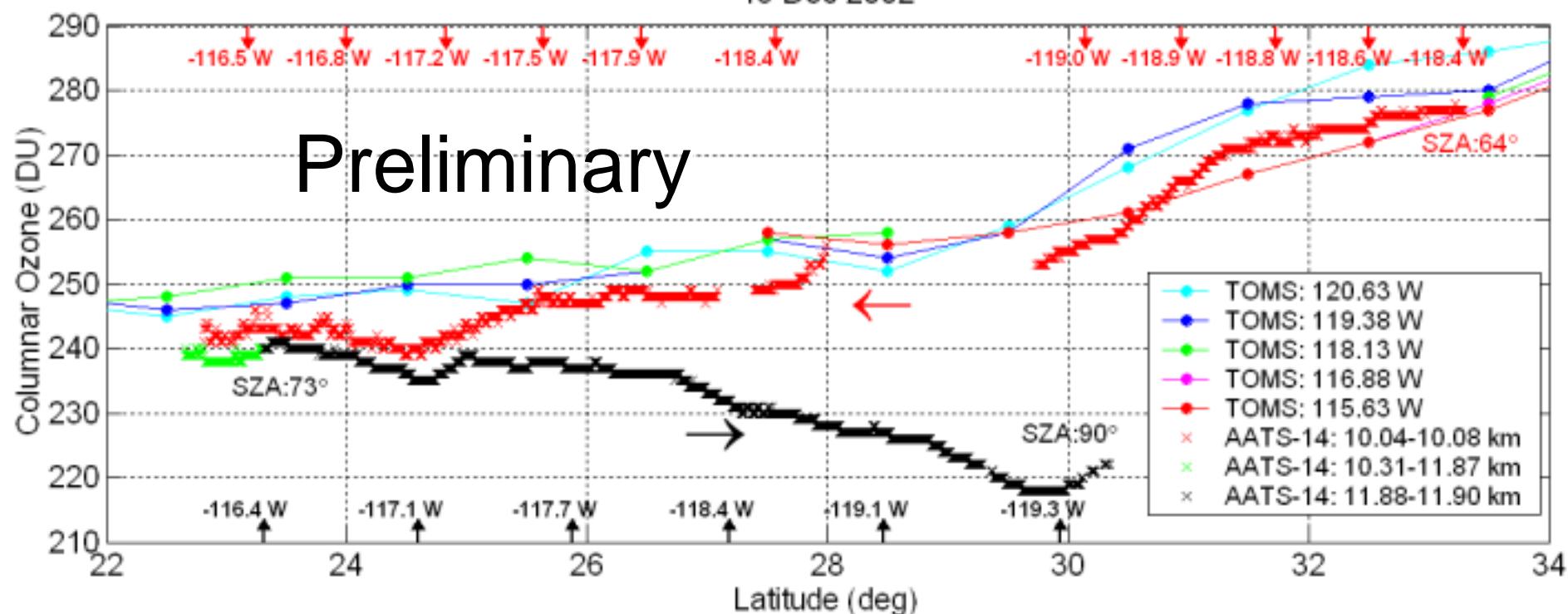
P. Russell et al., SOSST Meeting  
Williamsburg, VA, 6-8 May 2003

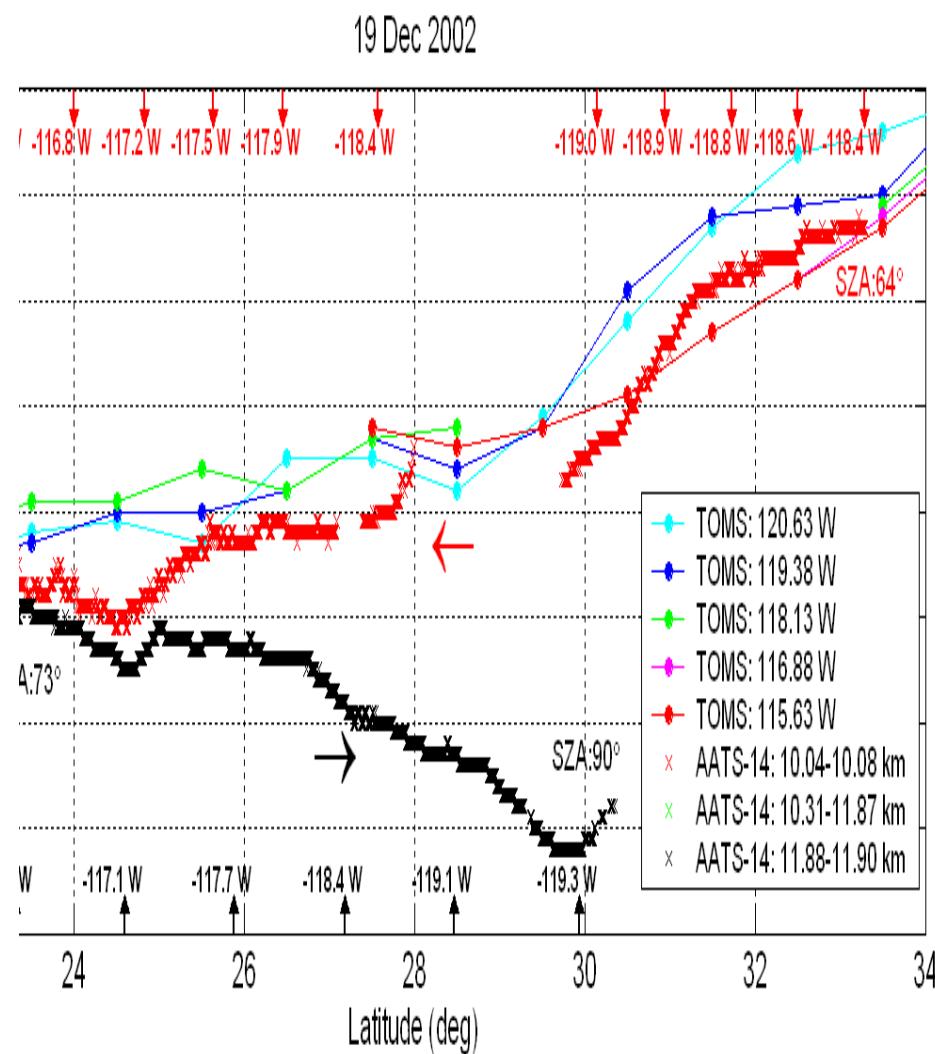
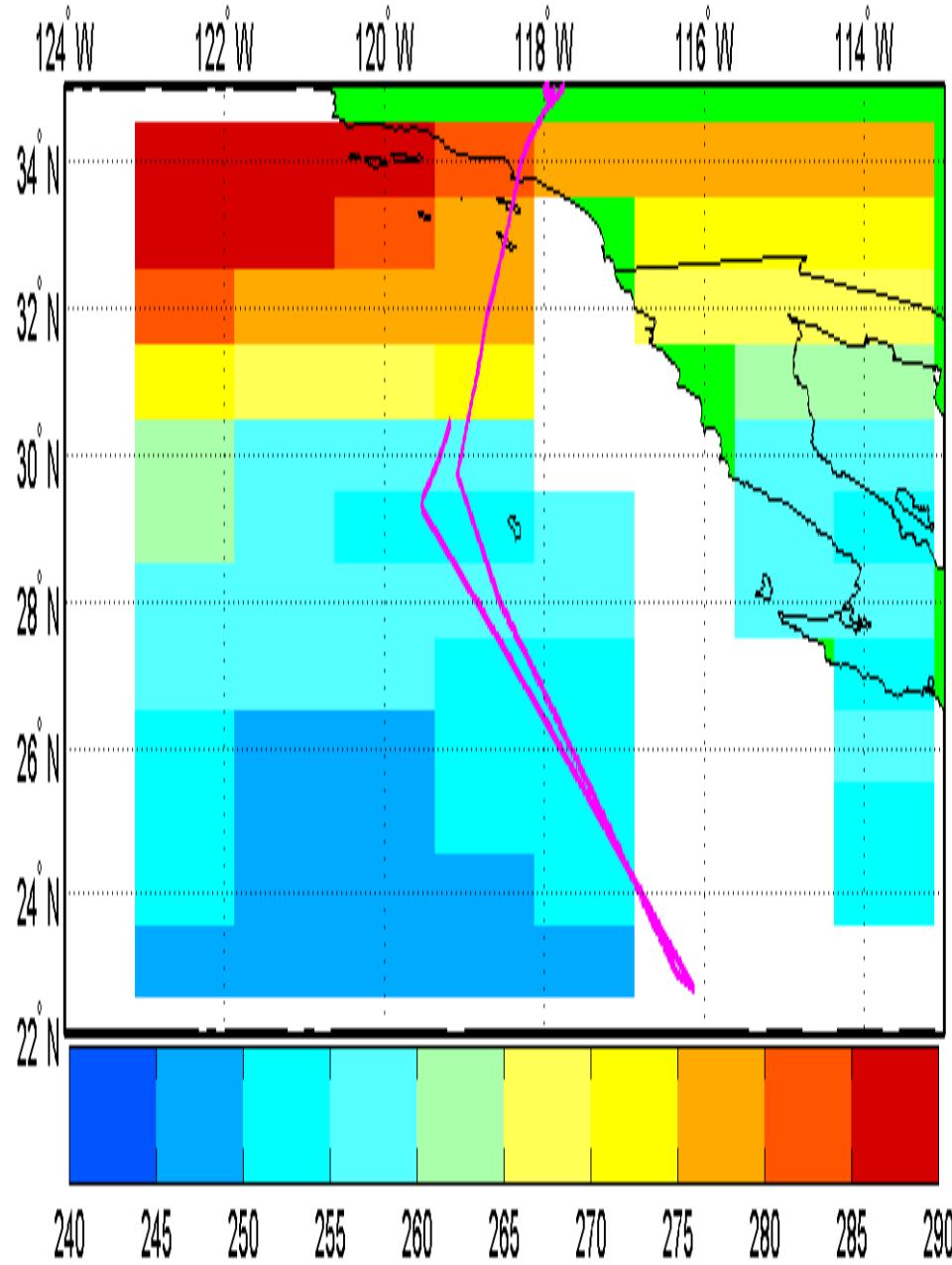
00 UT, 20 Dec. 02, 120W





19 Dec 2002



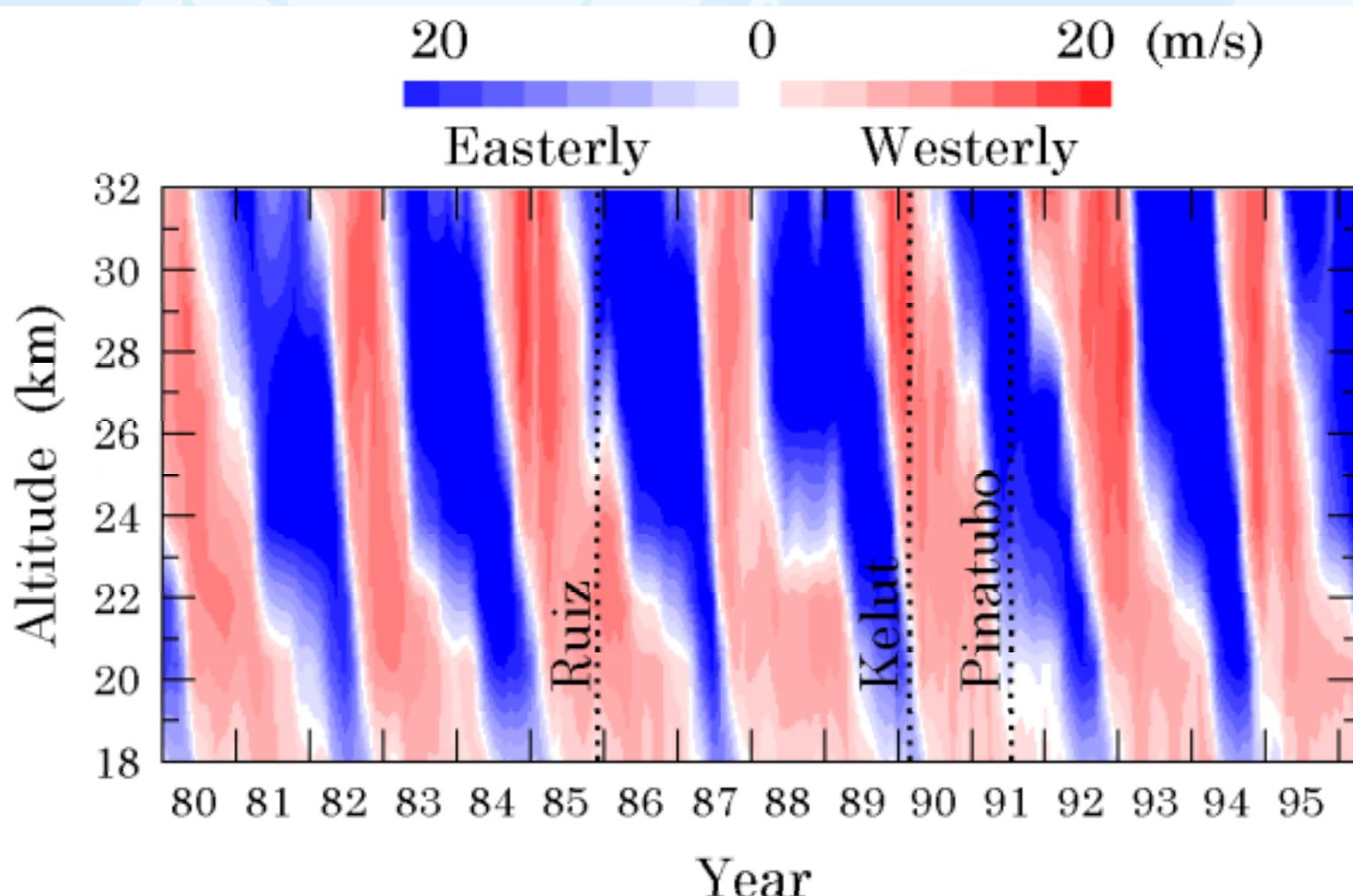


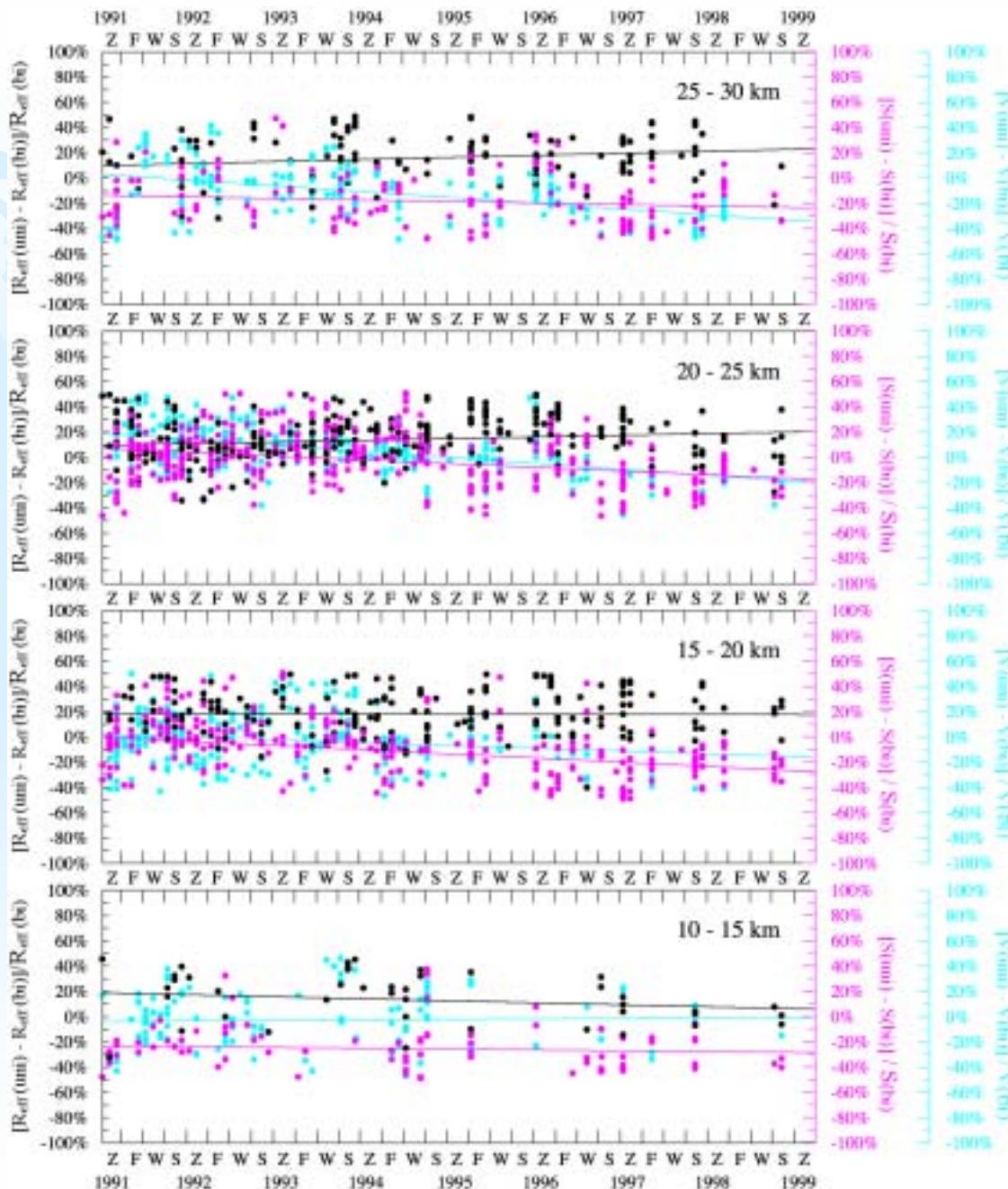
# Preliminary



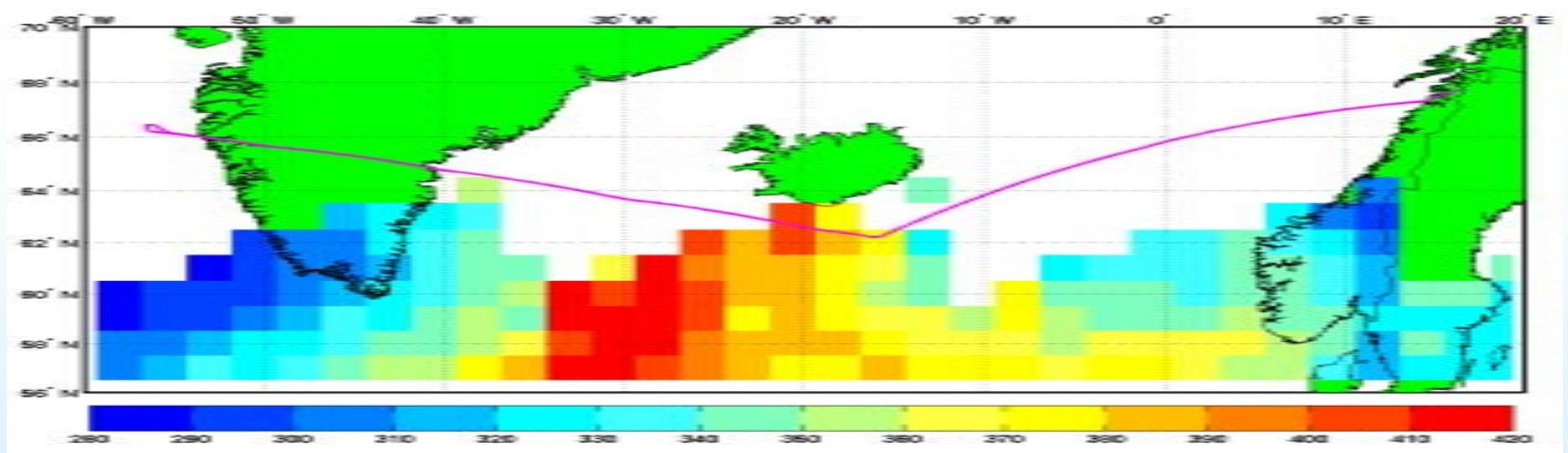


Shear phase and speed of the quasi-biennial oscillation (QBO) as a function of altitude from 1980 to 1996. Source Web Site: *Experiments on Geophysical Fluid Dynamics*, Kyoto University, Japan (<http://dennou-k.gaia.h.kyoto-u.ac.jp/>).

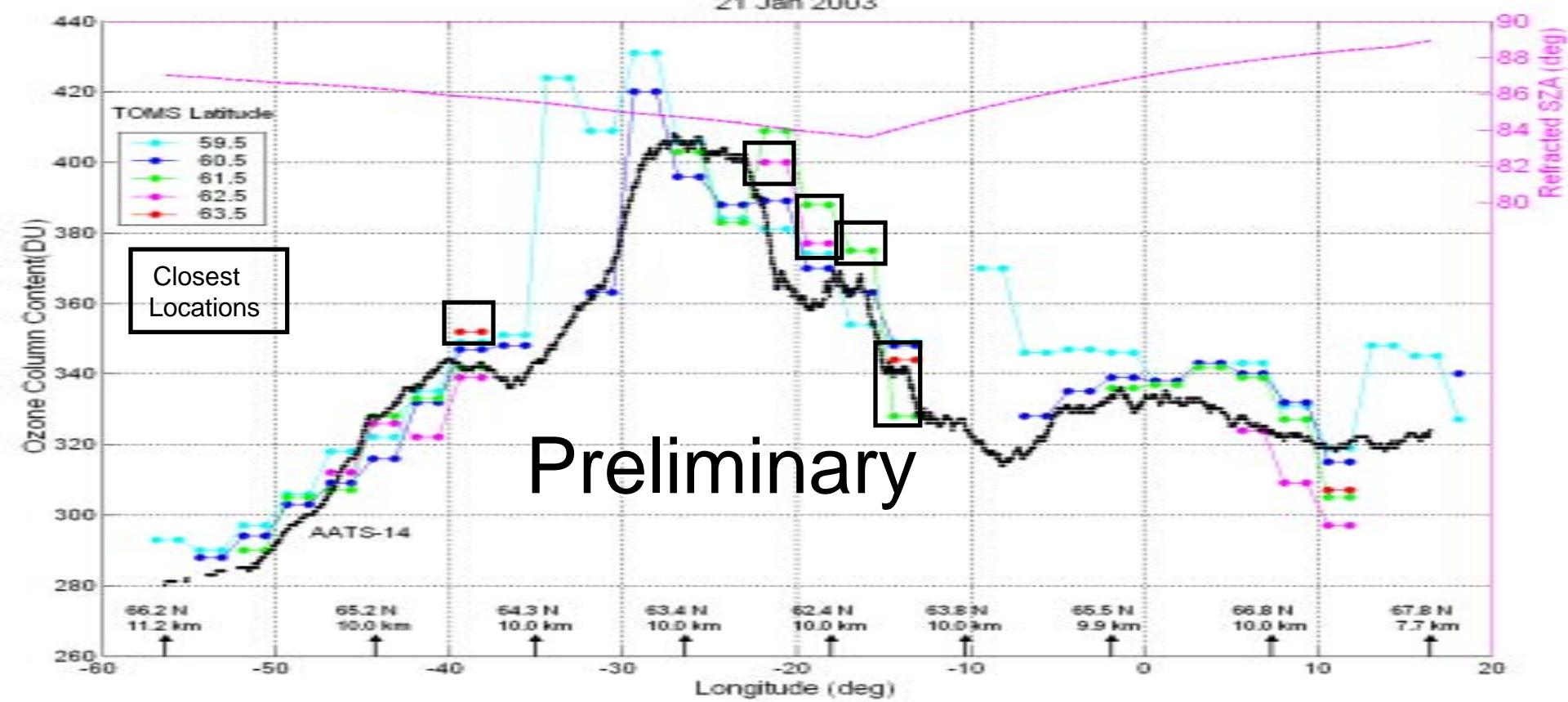




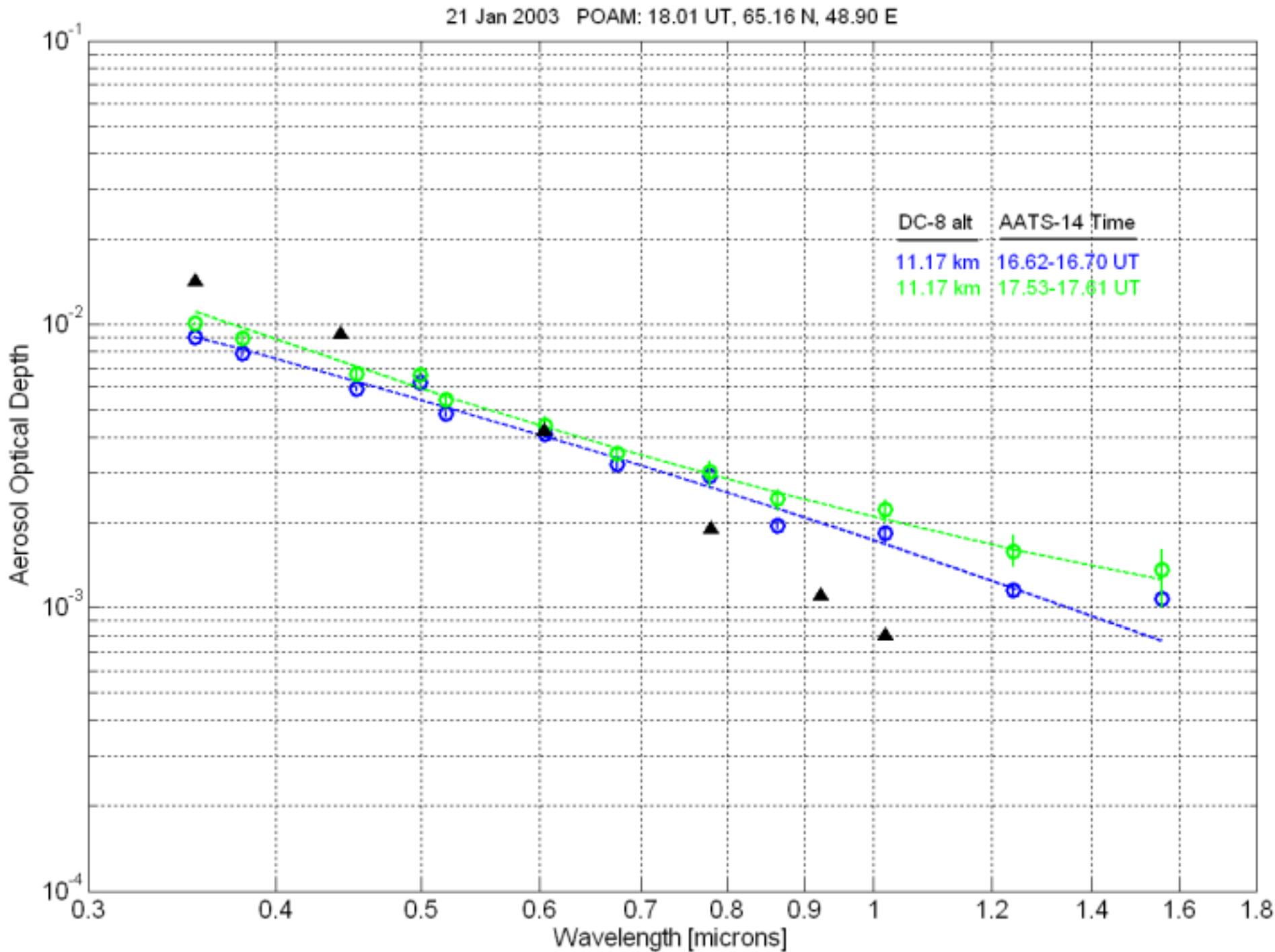
[Bauman et  
al.,  
*JGR 2003a*]



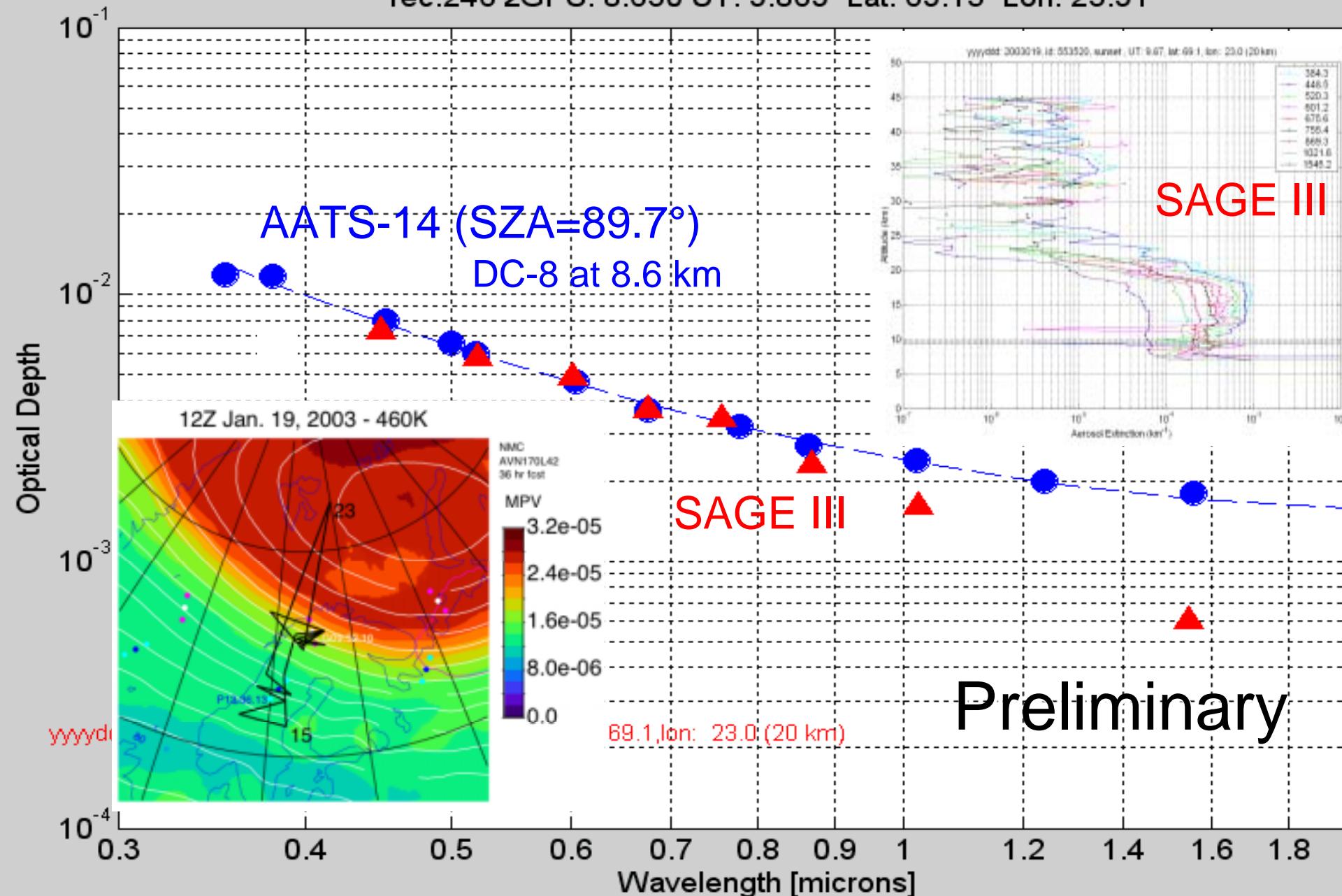
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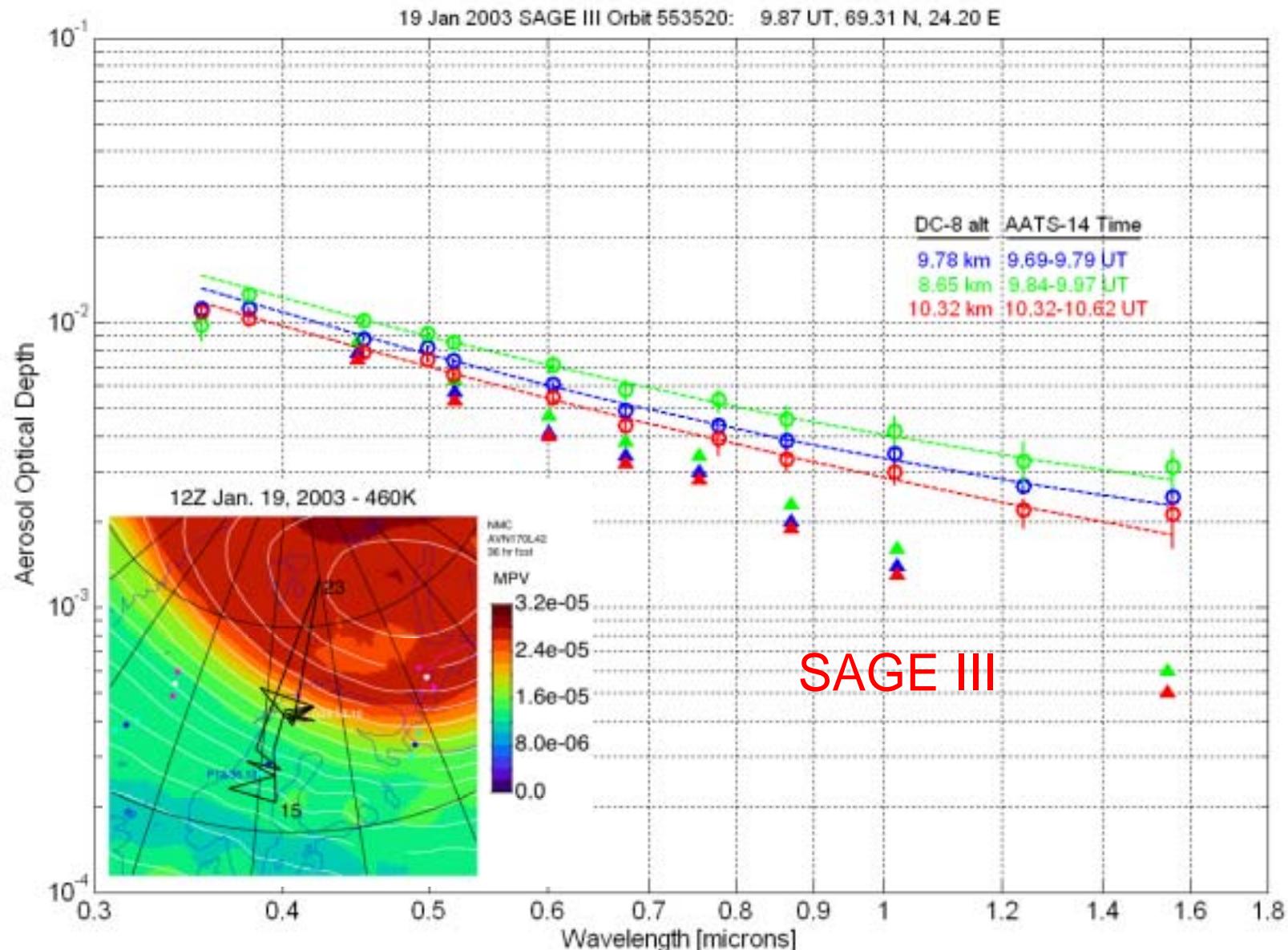


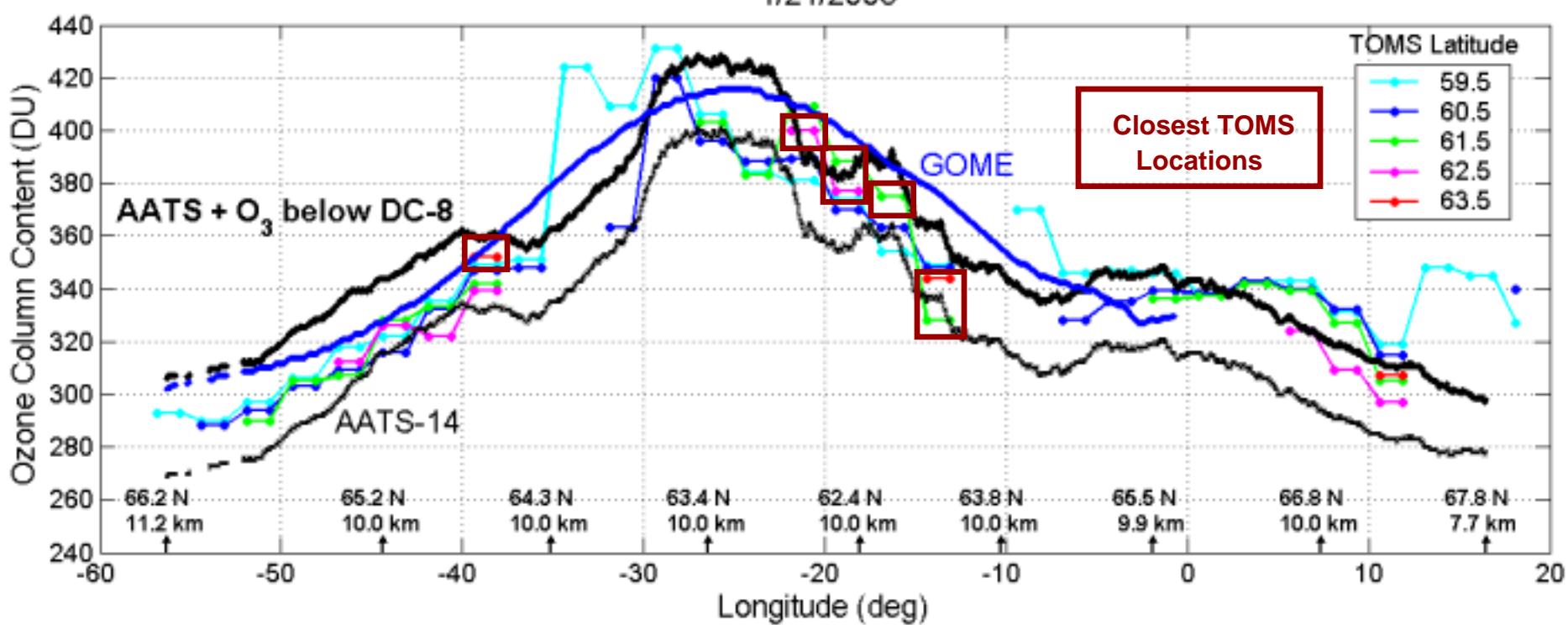
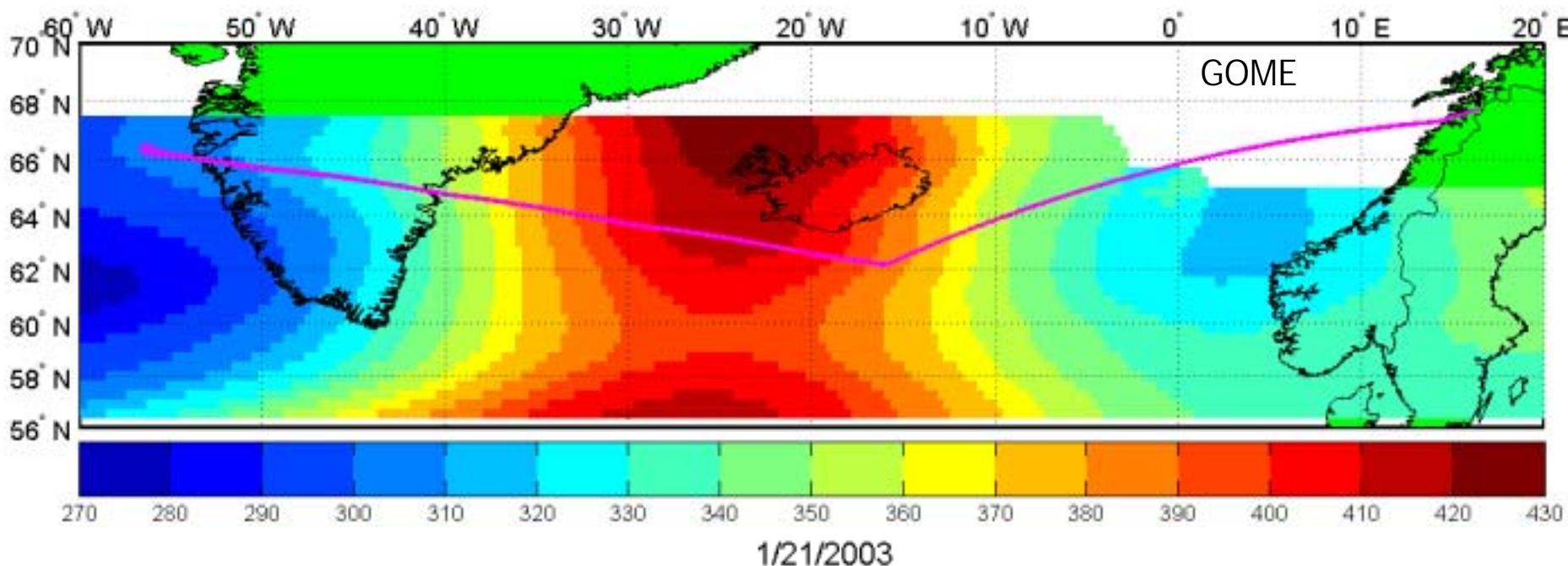
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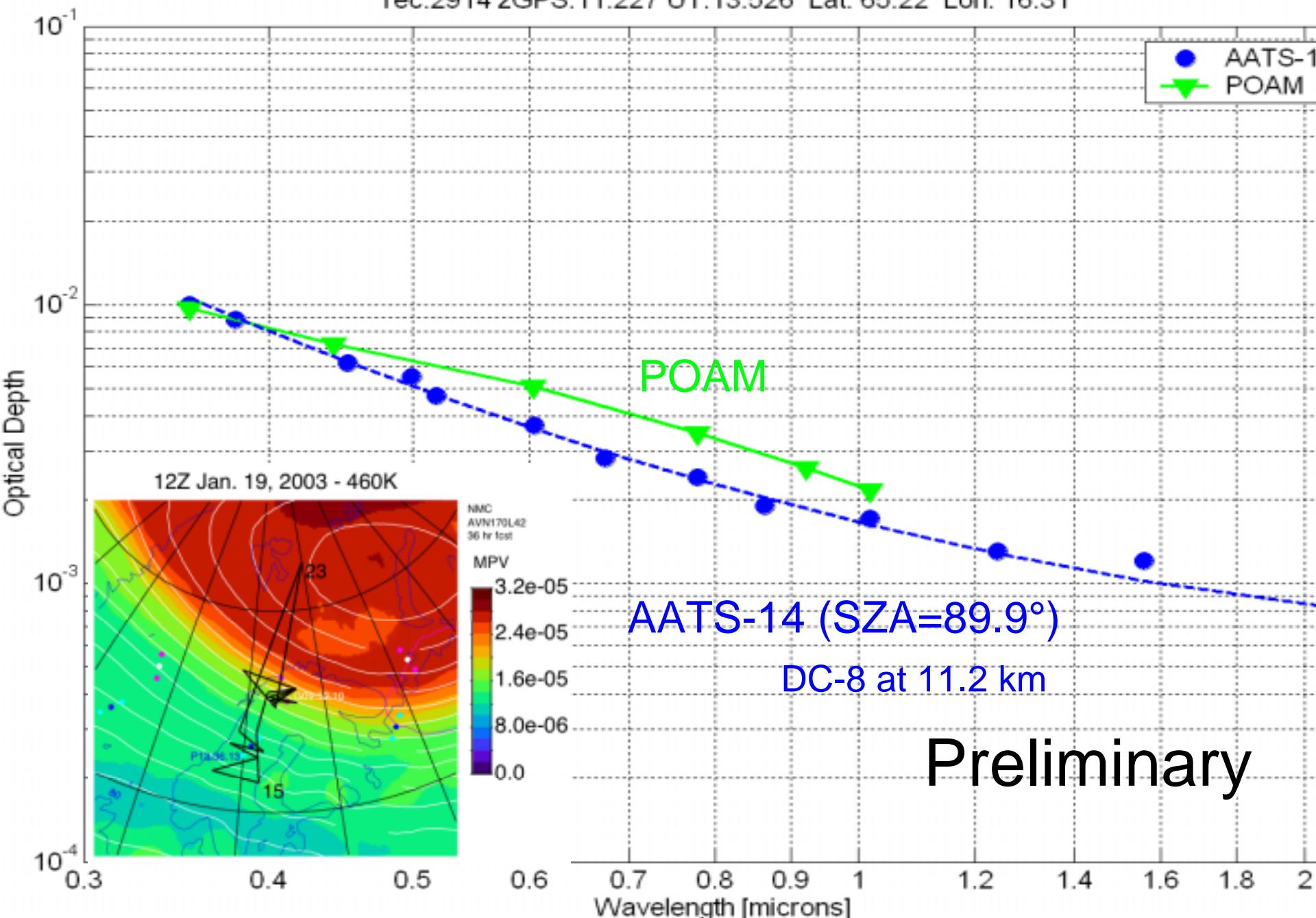


rec:246 zGPS: 8.630 UT: 9.869 Lat: 69.15 Lon: 23.91

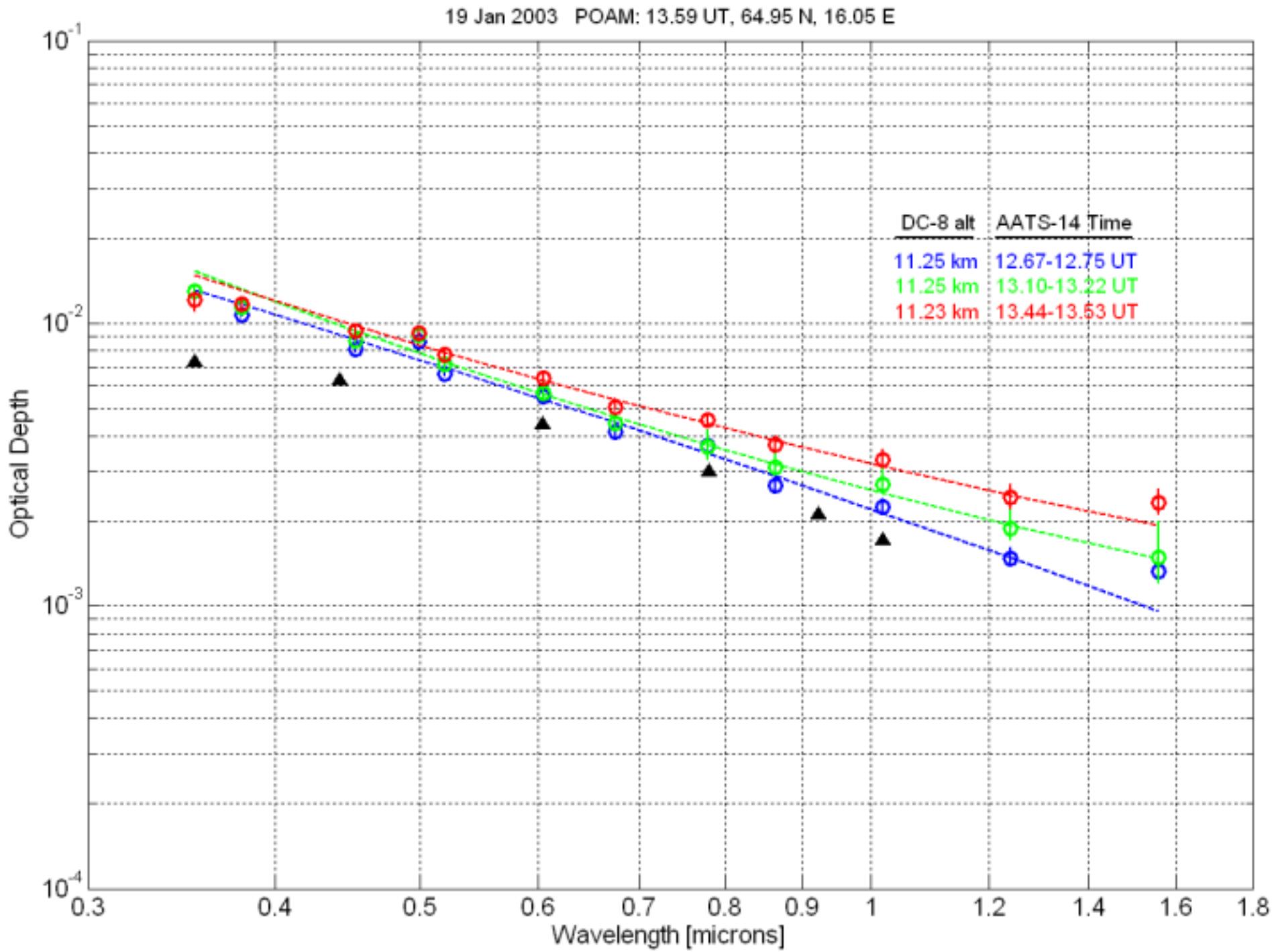


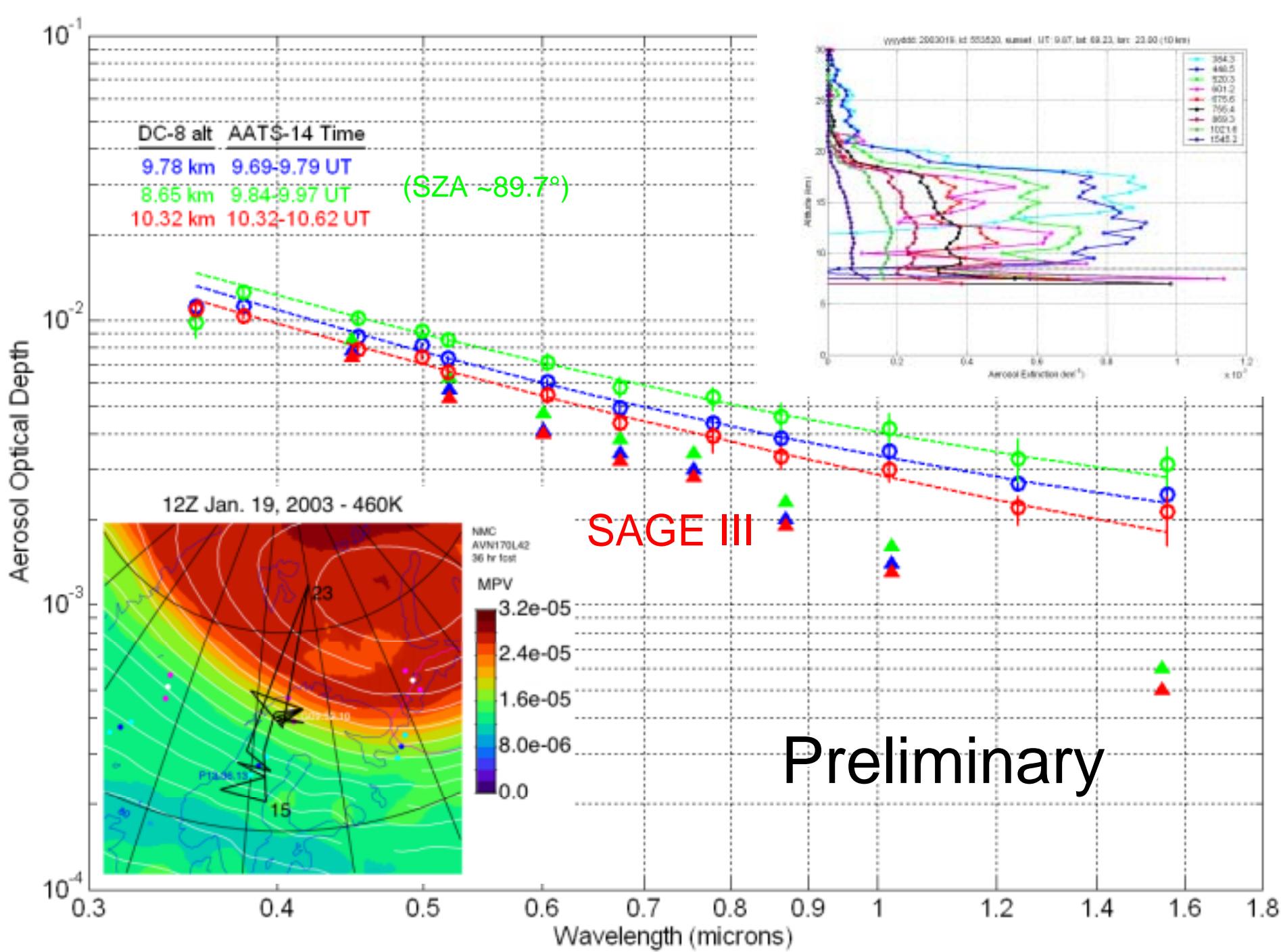






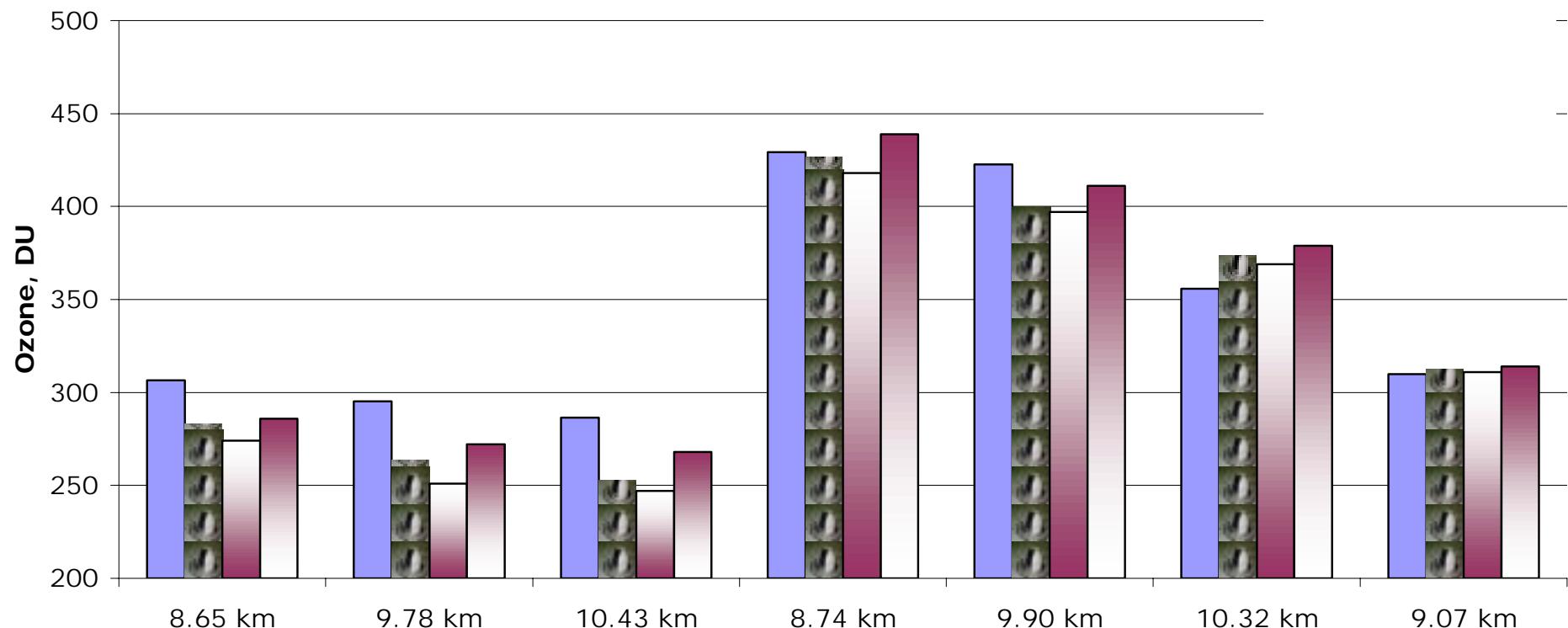
19 Jan 2003 POAM: 13.59 UT, 64.95 N, 16.05 E



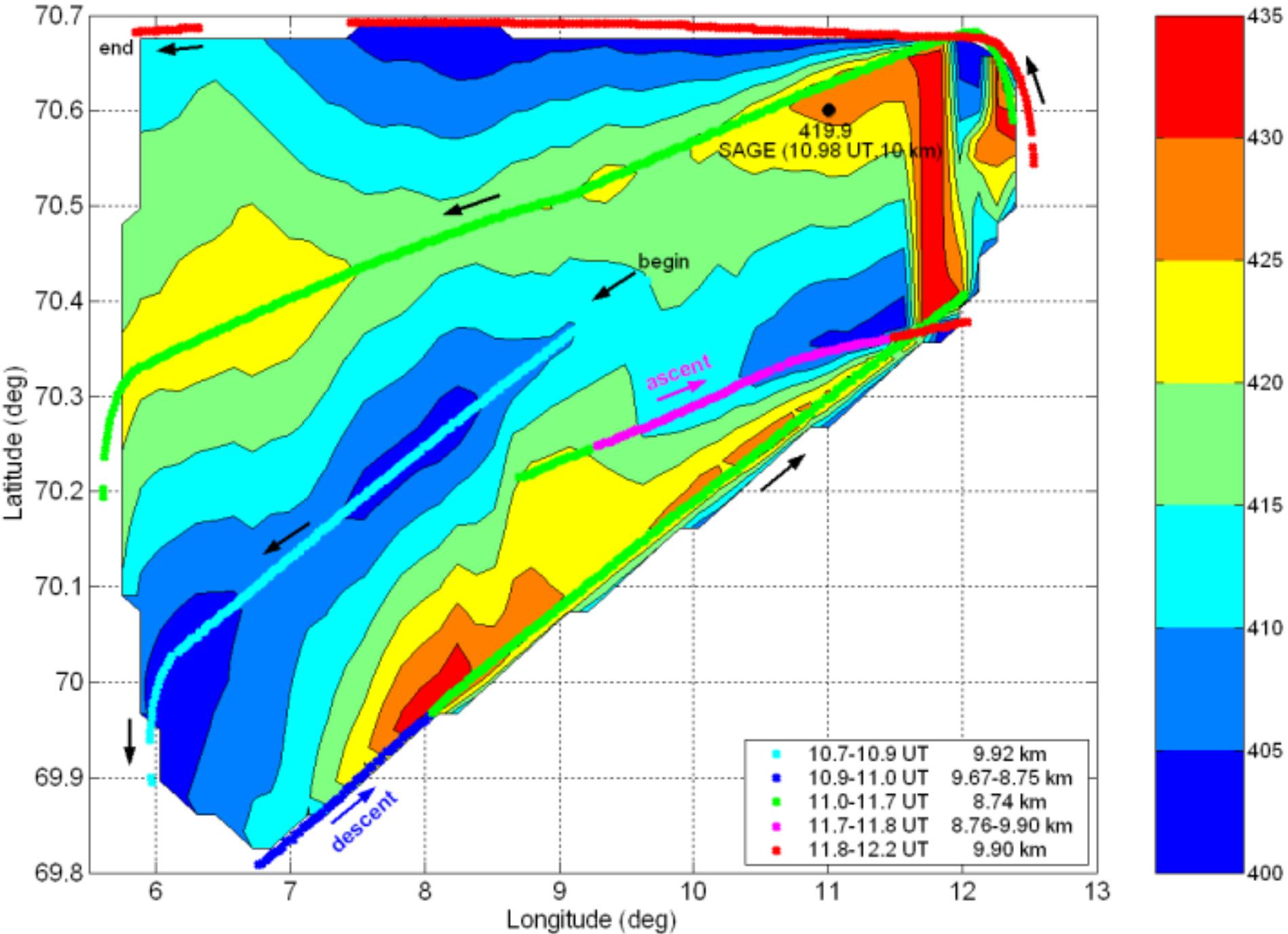




## AATS-14 & SAGE III Ozone, SOLVE II



# AATS-14 Ozone Column Content: 24 Jan 2003





## AATS-14 & SAGE III Ozone, SOLVE II

$\Delta X < 100 \text{ km}$

